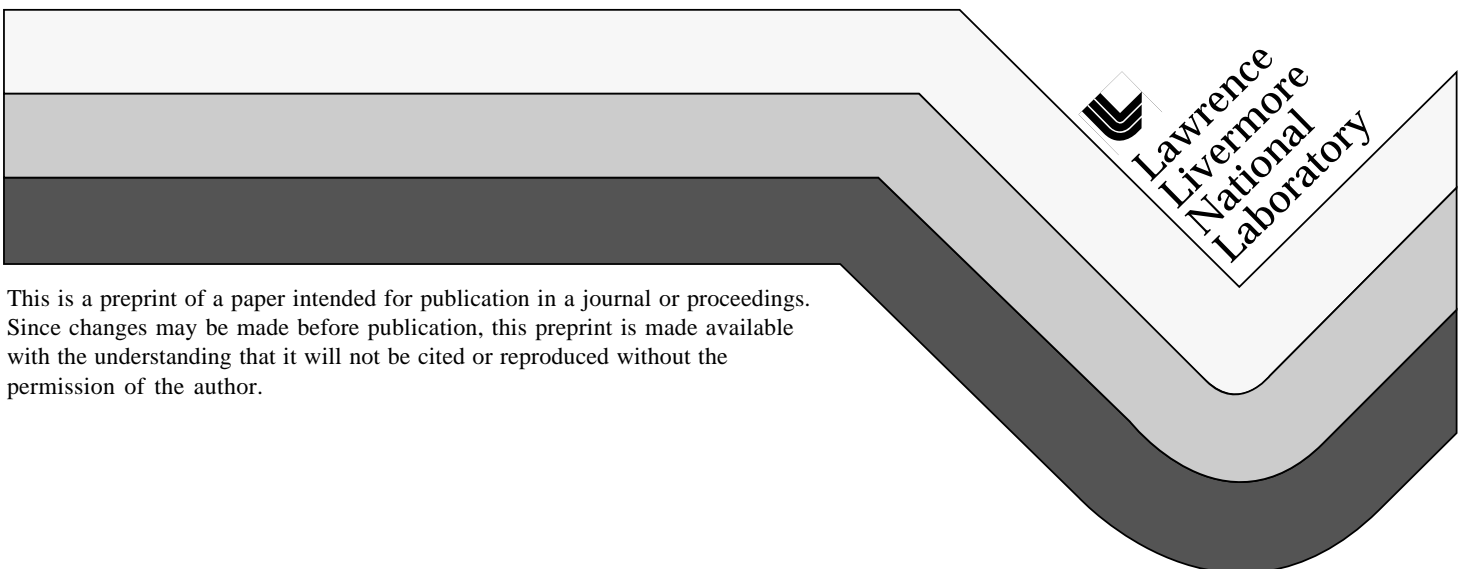


# **High-Tech Organizations: What Can They Tell Us About Reengineering (Grow and Reproduce, or Die)**

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(Grow and Reproduce, or Die)**

Fred J. Norton  
Plant Engineering

June 10, 1996

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# **High-Tech Organizations: What Can They Tell Us About Reengineering (Grow and Reproduce, or Die)**

## **Introduction**

High-tech organizations that are considering some form of reengineering in the face of heightened competition, while at the same time reducing costs, usually choose radical restructuring of information systems (IS) and engineering information (EI) systems operations and improved processes. In their book, *Reengineering the Corporation: A Manifesto for Business Revolution*, Michael Hammer and James Champy make this comment: “It is the disruptive power of technology, its ability to break the rules that limit how we conduct our work, that makes it critical to companies looking for competitive advantage.” Some organizations view this as a necessity, other a hindrance. Whatever the view, it has forever changed the way organizations do business.

Change is the norm of the 1990s, and it will continue to be a major factor in running a company and/or organization as the coming decades unfold. The former cycle of change followed by stability is gone; change as a continuous reality is the new cycle. The necessity to be customer-driven implies a fundamental transformation of the way organizations and their managers choose to do business. Much has been learned about the way people interact with IS/EI systems technologies. The cultures of the Department of Energy’s (DOE) National Laboratories are built on a research and development (R&D) mentality that greatly increases the difficulty of building an effective IS/EI systems cross-functional group for various organizations.

Classical planning approaches ignore cultural and organizational factors. These factors, however, are crucial in devising meaningful and relevant plans. Also, as more and more organizations strive to become competitive, the philosophy and concepts of total quality management (TQM) are receiving increased attention. This paper:

- Discusses the possibility of applying manufacturing reengineering techniques to other industries to help them overcome the risk of failure.
- Provides a comprehensive look at the changes that have occurred in the business environment since the advent of reengineering.
- Discusses why reengineering is so important and how people and executives of organizations can play even more pivotal roles as long-term strategists in there organizations.
- Introduces the concept of the core mission to planning.
- Provides business process redesign that takes into consideration the interaction of humans and technology.

## **Definition of Reengineering**

Hammer defines reengineering as the fundamental rethinking and radical redesign of business processes to achieve dramatic improvements in critical, contemporary measures, or performance (e.g., cost, quality, service, and speed). Reengineering is one of the things a company must do when they change direction. It is the rate of change

today that has increased to the point where organizations cannot predict five years from now what the application will be, particularly within the DOE National Laboratories. In many instances, it took two to three years to implement a R&D manufacturing information technology (IT) system.

Today, in the high-tech IS/EI systems R&D environment, these systems could be obsolete by that time, so an entirely different, more dynamic approach is required. Organizations start reengineering by being customer-focused, which means asking your customers what they want and how they want it. But, even more than that, it means knowing when they want it, the flexibility required, and the distribution methods. This, in turn, drives manufacturing processes to meet those needs better than the competition (i.e., other National Laboratories). Today, this means staying close to the customer.

What does work is reengineering. In the struggle to bring about change, reengineering provides organizations with the means to change work units from functional to process oriented, jobs themselves from simple tasks to multi-dimensional work, people's roles from controlled to empowered, training to educating, work measurement to results measurement, advancement based on performance to advancement based on ability, values from protective to productive, managers from supervisors to coaches, organizational structures from hierarchical to flat, and executives from scorekeepers to leaders.

## **The Key is Flexibility**

By referring to the business system diamond (*Reengineering the Corporation: A Manifesto for Business Revolution*, Michael Hammer and James Champy, p. 80), it can be seen that process redesign alone is not enough. For reengineering, companies must focus on all four points to achieve results. Information technology plays a vital role in business reengineering, in fact, Hammer calls it an essential enabler of reengineering. IS/EI does not, however, force organizations to reengineer. Companies are forced to reengineer by competition, customers, and change in the market. Without IT, however, reengineering would be a fantasy. In Hammer's opinion, companies have not even scratched the surface of what IT is going to do to organizations or businesses.

Even today, the backbone for reengineering manufacturing processes is going to be an IS/EI system that interfaces with the customer and puts on a single network all the people who have to make that product, including suppliers (i.e., both internally and externally to the DOE Laboratories).

Flexibility is a key factor. It means that if a competitor can read the market, manufacture many different products on the same line, switch from one to another instantly and at low cost, make as much profit on short runs as long ones, and bring out offerings faster than a company can (or do most of these things), the company loses. It has been shown that American companies are a generation behind on flexible manufacturing systems (FMS).

A basic shift in the organization of work with the widespread dismantling of Taylorism and the concept of an endlessly changing organizational design (i.e., a reconfigurable organization) that is small and flexible, have played a significant role in the management revolution that has enabled companies to embrace IS/EI in radically different ways. The new information-age economy is evolving, with its fundamental sources of wealth being knowledge and communication as opposed to natural resources and physical labor. In the future, sustainable competitive advantage will depend more



on new process technologies and less on new product technologies. Manmade comparative advantage replaces the comparative advantage of natural resources.

## **The New Revolution**

Today's companies are in the midst of a revolution that rivals the Industrial Revolution in scale and consequence. This revolution is driven by the globalization of markets, the spread of IS/EI and computer networks, the dismantling of organizational hierarchies, and the information-age economy. Each of these four revolutions is happening simultaneously, and they cause one another and affect one another.

Three phenomena of the modern U.S. business world are viewed by many observers as perhaps related, but how they are related usually is not clear. These are downsizing, business process reengineering (BPR), and quality improvement programs (QIP), which are often referred to in the context of TQM). These names are often used in different and sometimes conflicting ways. For example, the reengineering label has been applied to all sorts of business activities that could better be characterized in other ways.

In the minds of many people, downsizing is associated with massive, often arbitrary and perhaps unnecessary layoffs of employees, and some observers view BPR as a thinly veiled approach to justifying these layoffs. On the other hand, other people think of BPR as a rational approach to reducing head count, and still others do not view BPR at all as an activity for eliminating personnel. Still others relate BPR and QIP, perceiving both as focused on product quality or on the effectiveness of the organization. None of these phenomena has a standard definition, although certain attributes are likely to be found in most experts' definitions of each. As a basis for comparisons in this paper, I will use are downsizing, QIP and TQM, and BPR, which may be defined as follows:

- *Downsizing.* Downsizing is a significant and rapid decrease in the amount of resources, and especially personnel resources, associated with an organization or with a part of an organization. Its primary purpose is to dramatically improve financial performance by reducing costs.
- *Quality Improvement Program and Total Quality Management.* This is a long-term program to improve the quality of an organization's products and services. Its primary purpose is to increase the quality of one or more dimensions of an organization's or company's activities (often in response to a competitor's high quality), with the expectation that increasing quality will improve market position and increase profitability.
- *Business Process Reengineering.* Business process reengineering is a fresh start, that is, a new look at tasks and processes of an organization with respect to how they should be accomplished without regard to how they are presently done. The result is a completely new design (a "reengineering") of the tasks and processes. Its primary purpose is to increase effectiveness at accomplishing the company's management objectives, administrative and operations tasks, with the expectation that improved processes will improve market position and increase profitability.

Many organizations downsize, many organizations use BPR, and many organizations have adopted a QIP. Are these three related or similar, and if so, how? *One of the purposes of this document is to compare downsizing, QIP, and BPR along several dimensions, including their similarities and differences of intent, their approaches, the results of*

*their use, and how high-tech IS/EI systems technology is related to each other, and to the R&D environment.*

Little formal study of downsizing exists, but news accounts and anecdotal evidence have been widespread for at least a decade, and it is clear that a dramatically increased tempo of downsizing activities has occurred during the economic downturn beginning in the late 1980s. The QIP movement began to become prominent in the early 1980s as an attempt to achieve levels of quality comparable to some foreign companies, notably Japanese companies. Descriptions and studies of QIP and TQM have appeared in the literature and are cited at the end of this paper. Few systematic studies of BPR have been conducted, perhaps because BPR is a more recent phenomenon than the quality improvement movement.

With the Cold War ending in the 1990s, the DOE National Laboratories throughout the DOE complex are experiencing increased downsizing activities.

## **Why and How Initiated**

Downsizing is usually undertaken in response to a bottom-line financial crisis, although sometimes a organization's management recognizes that the company is operating with too many personnel and downsizes the various organizations even though it is doing well financially. In the usual situation, profitability is considered too low, and downsizing is a rapid response by management to low profits or to losses that may jeopardize the continued existence of the company. Although systematic, studied approaches can be used to determine which employees to release, the crisis nature of downsizing may result in rapid and drastic cutting of employees using a knee-jerk, every-unit-must-suffer-equally type of layoff. The latter is characterized as an across-the-board downsizing.

Quality improvement programs are not usually a response to a need to reduce costs, but instead are the consequence of a perception that if the quality of products and services is not substantially improved, competitors with higher quality products and services will reduce the company to impotence in the marketplace and the company then will face a financial crisis. QIP may start modestly in terms of scale and scope (e.g., within one division, one plant, or one department), may then escalate to programs that are comprehensive with respect to most aspects of a company's product and service quality, and often will continue for several years.

For example, to successfully compete for the prestigious Malcolm Baldrige Quality Award, quality must be exhibited and verified throughout a company. The 3M company is an example of a company with a long-lived program: it committed to the total quality process in 1979 and continues with it to this time.

Business process reengineering (BPR) is not directly concerned with quality; *BPR is a response to a perception that the company is not performing certain critical tasks effectively.* For example, it may take much longer than desired for the company, or organization, to prepare a job bid in response to a customer's request for a quote; that is, the quality of the task performance is not the primary concern, but the speed is. Each task of a company is accomplished as part of a process, and often the conduct of the entire process is hampered either by procedures requiring multiple delaying approvals and sign-offs, or by split jurisdiction over different parts of the entire task process so that cross-boundary hand-offs are not efficient.

The preceding paragraphs contain the most critical distinctive feature of each of the three phenomena; the following features are principally responsible for other attributes that distinguish each phenomenon from the other two:

- *Downsizing*. The focus is on rapid resource reduction to reduce costs.
- *QIP*. The focus is on continuously improving product quality and service quality (and perhaps also on the quality of other dimensions of company activities). There is not necessarily any attention given to cost reduction; indeed, costs may increase during a QIP (especially in the short run). Also, there is not necessarily a complete redesign of business processes, although process improvement is a likely outcome.
- *BPR*. The focus is on management, operating, and administrative process redesign. There is no explicit focus on cost reduction and the frequent outcome of BPR of identifying and removing redundant personnel is incidental to its purpose. Although BPR does not necessarily involve direct concern for product or service quality, an improved process may improve service quality, and perhaps even product quality.

None of these three activities is directed toward improving revenue. Indeed, downsizing can be damaging to services or sales. The effects of QIP and BPR on revenue are indirect, and in certain cases may result in revenue increases only in the longer term, if at all.

## **Benefits**

Below are some of the benefits to the downsizing process, the quality programs, and business process reengineering.

### **Downsizing**

The anticipated benefits from downsizing (i.e., reduced operating costs) may be achieved rapidly. The total effect of severance benefits, early retirement programs, placement counseling and other costs of layoffs, however, may substantially reduce the cost savings.

Where the alternative to downsizing is seen as the entity's going out of existence (e.g., from insolvency or from being acquired because of declining performance of its stock in the stock market), downsizing may be viewed as absolutely necessary. In the long term, however, downsizing may actually increase overall costs and reduce an organization's ability to compete.

If you have been reading the business sections of many newspapers, company after company has been announcing large reductions in the workforce. Many of the DOE National Laboratories are having to reduce their manpower because of major reductions in programs and budgets. These companies and organizations, including the DOE National Laboratories, were announcing the eradication of loyalty at the same time.

Other authors speak of a vanishing sense of order at the company, of the loss of institutional memory, of the loss of experience, of the loss of contacts and infrastructure, and of a negative or neutral effect on quality; all of these can be the cause of subsequent inefficient operations.

Additionally, an American Management Association study has shown that almost three-quarters of the companies in the study report a decline in employee morale as a

result of downsizing, and others note that lower employee morale could have long-term deleterious (i.e., harmful) effects on the companies and organizations. Not only is the lowered morale the result of stress during the purge of employees and a sense of unfairness to those who depart, the remaining employees know that a second downsizing may follow in a year or two; this keeps stress and organizational instability high and is likely to reduce productivity. Apparently, most companies do not gain sufficient long-term benefits from one downsizing.

A possible happy outcome of downsizing is that a successful downsizing (i.e., one that does reduce costs substantially with a minimum of long-term detrimental effects) may buy a company or organization time to pursue and cure the fundamental ills that forced the company to downsize, such as poor quality or ineffective operations. However, an American Management Association study indicates that fewer than one-half the companies that downsized experienced an increase in operating profits. Also, a study by Kepner-Tregoe shows that more than half the downsized companies experienced a negative or neutral effect on quality.

### **Quality Improvement Programs**

The usual benefits sought from QIP are better product quality, greater product differentiation, improved competitive position, and increased customer satisfaction. In addition, a QIP may provide a long-term positioning that leads to cost leadership. Diligent, long-term pursuit of a quality improvement program often does provide some or all of these benefits, perhaps including reduced costs. However, quality improvement also has its perils. It has been said that failed attempts at implementing quality practices are common, and that these failures have led to a massive waste of resources over the last decade.

QIP require changes in the culture and value of an organization. This is confirmed by a study done by the Business Round Table involving CEOs and Quality officers, which found that 91% of the participants believe that these culture and value changes are necessary for effective implementation of a total quality management program. This culture and value set might be summarized as: We must pay very careful attention to quality because that is what the customer wants and we must satisfy the customer. Perhaps the most important consequence of a successful QIP for a company is that this culture and value transformation becomes pervasive throughout the company, even in those parts of the company that do not deal directly with customers.

### **Business Process Reengineering**

The benefits from BPR most frequently noted are better customer service, changed (i.e., improved) management processes, and greater administrative efficiency. Several other benefits also are seen as important. Typically, each BPR project, according to the study, confers some degree of several of those benefits. *The most frequently cited benefit of BPR is better customer service.* Therefore, like QIP, a BPR project may provide a strong focus on customers to achieve the benefits of better customer service and greater customer satisfaction.

Although QIP programs almost always focus on satisfying the customer, however, BPR projects are varied and may involve purely administrative or other processes that are entirely internal. Whereas all of a QIP is focused on customer satisfaction, with BPR it is only those projects that deal directly with customer-related processes that are likely to have a clear customer satisfaction focus.

Increasing service and/or product differentiation is a frequent objective of quality improvement programs that is completely absent in BPR projects. Also, *BPR's benefits of changes in management processes, greater administrative effectiveness, and changes in organization structure appear to represent a focus that is quite different from that of quality improvement programs*, even though a QIP may provide some degree of these benefits without directly seeking them. The fifth benefit of the BPR is product quality improvements; this represents an area of benefits of critical importance with QIP, whereas product quality has been found to be a benefit encountered less often than are other benefits of BPR.

BPR is not an unmitigated success with respect to benefits. Participants in studies were asked what significant negative effects they observed from BPR in their company or organization. Several participants agreed that “deteriorated operating environment or morale, or higher turnover of valued employees” was observed after processes were reengineered. In the same study, 16 negative effects were cited. With nearly 150 citations of benefits of BPR, *the benefits of BPR appear to completely overwhelm the perceived negative effects of BPR*.

## **Focus on Methodology**

### **Downsizing**

The primary intent of downsizing is cost reduction, and this is usually accomplished primarily by a reduction in the number of employees. Although middle managers traditionally have been nearly immune to downsizing layoffs, during the last several years this has changed; middle levels have been downsized as much as or proportionately more than hourly, technical, clerical, and blue-collar workers. It is evident from all the literature that I have read that approximately 20% of the jobs eliminated by downsizing were middle management positions.

The overall approach to downsizing appears to be straightforward. The downsizing approach in its pure form does not embrace restructuring of work tasks processes. Some attention may be paid to which positions are filled by employees who are the highest paid (especially with respect to those employees whose employee benefits might continue to contribute to expense overhead for decades), which employees have the greatest capacity for future growth, and which employees qualify for tenure. *Speed of downsizing usually is important*, so it is unusual that during a downsizing activity a full-scale effort is made to streamline the entire company to make it more efficient with fewer employees, especially if such an effort would add to costs (e.g., by increasing employees education benefits).

*A particularly insidious approach to downsizing is cross-the-board layoffs*. Although seemingly even-handed, this kind of layoff ignores differences among units (e.g., a group could play a role in destruction of a company's most profitable activities).

### **Quality Improvement Programs**

The primary foci of a QIP are on improving quality and especially on providing products and services that consistently meet or exceed the customer's expectations. In some companies, “customer” is defined to include internal customers, that is, those individuals or groups within a company, or organization, to which another group provides services or products. Unlike downsizing, QIPs use numerous improvements

and analysis methodologies (e.g., quality circles, benchmarking, statistical quality control, quality improvement teams, Pareto diagrams, and continuous improvement techniques). *However, each company and/or organization uses its own unique version of each technique as well as its own blended set of techniques.*

The criteria and standards embodied in the Malcolm Baldrige National Quality Award application make it an overall framework for product and service quality that has been adopted by many American companies, including many that do not plan to apply for the prestigious award. These criteria and standards are embodied in the Baldrige Award point evaluating system, which has seven categories in which a company can score points for quality improvements.

As one part of one of these seven categories (i.e., the Quality Assurance of Products and Services category), the Baldrige approach is concerned with understanding processes (e.g., mapping them with process flow diagrams) to improve the processes that are important to the company; however, the approach says nothing about replacing (reengineering) these processes as would be done with BPR. *Of the seven categories, the Customer Satisfaction category is the most heavily weighted, and this weighting accurately reflects the very heavy emphasis on customer-related activities of companies that adopt the framework and standards of the Baldrige Award.*

## **Business Process Reengineering**

In BPR, the focus of efforts and emphasis is first on analyzing each *process* as if it did not previously exist (i.e., a zero-based approach), then on determining how, ideally, the process task should be performed without regard to how it is now performed, and then on building the process management system and the process information technology support system that best supports the new process.

Initially (and in theory, at least), the functional organization structure and functional systems are ignored (i.e., existing hierarchies for task accomplishment, approvals, and so on, and the information systems that already support them, are ignored).

Because many processes cross functional boundaries, the new process management and process information systems often restructure the organization's hierarchy, and typically BPR flattens the task-performing structures of an organization. *James Champy extends this cross-boundary concept by saying people take all the fragmented work that has been done in multiple pieces of the organization and learn to synthesize those tasks back into units of work that a single person or a small team can do.*

Often, the administrative and supervisory task hierarchy also shrinks when an operations process is reengineered. However, it is possible for the extant administrative or supervisory function-based hierarchy to remain intact and coexist with the reengineered and cross-functionally integrated, flattened operating process so that, in effect, a dual-hierarchy organization exists.

The usual effect of BPR is faster, more efficient and more effective business processes that make the company more responsive to the market place and that provide better quality customer services. However, quality *per se* is not the objective, nor is efficiency (i.e., reduced costs). Personnel reductions are incidental to BPR, but more streamlined processes are likely to mean that fewer people can accomplish the same tasks faster and better.

Because the BPR uses a project approach, it is accomplished on a careful, non-crisis, process-by-process basis; often the company is stable, and may even be growing and profitable, when it initiates the BPR. The length of each project varies but may be as short as one month; as each process redesign is implemented, the benefits of that

redesign begin to be received. Therefore, some benefits from BPR can be received in a short-to-medium time frame.

Because the BPR is a process-replacement activity done on a project basis, *each process redesign is more-or-less independent of the others. Therefore, although QIP is an integrated and broad program, BPR is a program primarily only to the extent that it is a series of linked projects. Also, the BPR does not have the same continuous improvement characteristics as a QIP*; that is, when a BPR project is completed, there may be no subsequent improvement within the foreseeable future. For these reasons, the BPR is not likely to provide anywhere near the corporate culture and values changes as will a QIP, which may elevate quality and customer satisfaction to a near-worship status.

The literature about BPR emphasizes its cross-functional dimensions. One study showed that cross-boundary BPR projects are indeed common in participants' companies. The findings on this project are instructive. The three most frequent cross-boundary BPR projects among the studied companies in terms of both extensive and some BPR activity are across

- Customer-related areas.
- Geographical areas.
- Product management and manufacturing.

This is accomplished in the order shown above. Indeed, numerous individuals have indicated some BPR activity across boundaries in almost every area; this shows that BPR activities across organizational (and geographical) boundaries are common. Clearly, the two categories of customer service and delivery and distribution have seen the greatest amount of within-area BPR activity among these companies.

The Baldrige Award and similar QIP programs place a direct emphasis on customer-related quality (i.e., by the customer satisfaction criteria). It appears that for BPR the most important orientation of both cross-boundary and with-function projects is also on customer-related activities, even though BPR is not specifically or necessarily focused on customers. Therefore, *the BPR increases the quality of customer service if the particular BPR project chosen is itself directly related to a customer*, whereas improving customer service quality is an essential focus for all Baldrige-like QIPs.

BPR is a relatively recent phenomenon. Based on the literature and studies I have encountered, it is reasonable to believe that the participants in some of the studies are managers in companies that are close to the leading edge of the BPR movement. For QIP, the Baldrige Award is more than six years old, and many companies began their QIP well before then. Unlike the QIP movement, with its established set of tools and with the Baldrige Award framework for guidance, there is no BPR framework. BPR methodologies are not yet well developed, and each company and/or organization appears to use its own analysis and implementation techniques to implement its own concept of BPR.

## **Effectiveness of the Programs**

### **Downsizing**

As previously noted, frequently there appear to be negative consequences from downsizing. These consequences may reduce the expected cost savings even in the short run and may jeopardize a company's ability to compete in the longer run. The

already noted need of many companies for additional downsizing after the first round indicates that the first downsizing, at least, often is not sufficiently effective.

Downsizing, *per se*, reduces head count but does not bring about reforms or improvements in management or operations. Downsizing can lull a company into thinking that its financial crisis has been dealt with, when in fact the crisis may continue or recur because the fundamental causes of the crisis have not been addressed. These fundamental causes should be dealt with during or after downsizing by other means, such as with QIP or with BPR projects.

## **Quality Improvement Programs**

Quality improvement programs are long term in nature. Sustained senior management leadership and continuous improvement are spoken of as elements of success. A study by the Business Round Table shows that a preponderance of CEOs and Quality Officers (64%) agree or strongly agree with the statement in reference to a TQM program that, because quality involves culture change, it inherently takes five to seven years.

During this long term and on into perpetuity, a QIP causes expenditures, and this cost of QIP may be a concern for companies. It has been argued that this concern is misplaced, and others state that QIP is a long-term approach that not only can ultimately reduce costs but also can increase revenues. Companies that have successful long-term QIP programs report major increases in product and service quality; that is, major improvements in the customer satisfaction that is the focus of QIP. *A QIP, however, usually does increase costs in the short run as the program ramps up, and so its short-term effect on costs is opposite to that of downsizing.*

Nor does a successful QIP program necessarily improve a company's profitability; several winners of the Baldrige Award have experienced decreased profitability after winning this prestigious award. *There appears to be no direct link between increased revenues and profitability of a company and its QIP programs.* Although this has been used as a criticism of QIPs, this criticism seems unwarranted. QIP does not and could not insulate companies from economic conditions; consumer taste changes, as do a multitude of other profit-determining factors. It is argued that the Baldrige Award is a strong predictor of long-term survival and a leading indicator of future profitability.

## **Business Process Reengineering**

One study has shown that BPR is effective. Below is a summary of comments about the effects of BPR on participative companies:

- Shorter production cycle.
- Consistent information.
- Richer jobs.
- Better asset use.
- More focus on teams, not individuals.
- Eliminates managerial levels.
- Less management approval.
- Functions now performed at lower levels.
- Fewer handoffs/interventions for decision-making.
- Administrators spend more time on important issues.
- Pushing quality responsibility lower in the organization has improved quality.
- Improved response time on proposals.



- Same tasks reduced from days to hours.
- Late shipments have virtually disappeared since teams do their own scheduling.
- Consistency of information across functional lines.
- Reduced inventories and shorter production lines.

The effectiveness of the BPR in the participants' companies is further indicated by responses to a question about BPR's effect on each participant's company and on the economy. Respondents strongly disagree that BPR is adversely affecting the economy (with a score of 3.8 out of 5.0, where 5.0 means not at all). Even more strongly, the overall score indicates that respondents believe that the BPR is not adversely affecting their company's culture (4.0 out of 5.0).

In addition, respondents clearly believe that BPR is necessary for their company's and/or organization's competitiveness (1.8 out of 5.0, where 1.0 is definitely), for the competitiveness of U.S. companies, and for instilling confidence in the competitiveness of the U.S. economy in general. BPR, being a younger phenomenon, is not so widely known or acknowledged, but it also appears to be important to the competitiveness of the U.S. companies, as well as to the overall position of the U.S. economy in the world's marketplace.

The most strongly held belief shown in the study about the overall role of BPR is that BPR is not another fad that will soon fade away (4.4 out of 5.0). This strongly held belief indicates not only that BPR is an important phenomenon now, but also that it will continue to be as, or more, important in the future. This conclusion is reinforced by the fact that it is the senior managers (e.g., general managers) who participated in the study who hold this view the most strongly. A separate tabulation for the 18 general managers answered 4.8 out of 5. Indeed, other questions in the study indicate that the participants strongly believe that, during the next five years, BPR activities will increase in intensity and become broader in scope, and that the importance of BPR activities will increase. It seems likely that the importance of QIP also will continue to increase.

## **Use of Information Technology**

### **Downsizing**

Information systems/engineering information technology can play a role in helping a downsized company and/or organization survive and recover. The prior existence of database systems that contain much of the institutional memory, the existence of expert systems that also may contain the specialized knowledge of certain experts, computerized management control systems that may permit managers to extend their spans of control, and executive information systems that enable senior and middle management to monitor operations and key operating statistics in a nearly real-time mode (i.e., typically, on a daily basis); all can help a company do more with fewer personnel.

A downsizing company and/or organization may also adopt a strategy of becoming more capital intensive by substituting IS/EI systems for personnel. Generally, however, if these systems are not already in place prior to downsizing, their implementation will be completed too late to assist in maintaining a company's equilibrium and capabilities after a downsizing.

A downsizing activity also may decimate an existing IS/EI computer technology group, which may mean that for a period of time at least, the company's and/or

organization's existing IS/EI systems will deteriorate and there will be no new IS/EI initiatives. Also, IS/EI system personnel are at high risk of being downsized out of jobs either as a consequence of across-the-board cuts or because they are considered to be overhead costs; often, employees who are in overhead positions (versus operations positions) are most vulnerable to downsizing. For example, in one organization, all new IS projects were canceled and 60% of the programmers, systems analysts, and systems managers were laid off as a part of a cost saving activity. NOT A VERY GOOD MOVE.

### **Quality Improvement Programs**

Quality improvement program methodology barely deals with IS/EI systems technology *per se*. QIP emphasis is on quality and on customer satisfaction, and each company and/or organization may use IS/EI or not use IS/EI systems technology in its own fashion to help improve these two items. The QIP technique of process mapping for the purpose of process improvement and the QIP concept of continuous improvement imply that certain of the process improvements may be improvements of IS/EI systems technology that support the processes, and that this may occur on a continuing basis. This evolutionary approach to systems development has been routinely followed in systems work under the name of systems maintenance.

However, just-in-time (JIT) and Kan Ban approaches, both likely to be a consequence of a quality improvement activity, do have implications for IS/EI systems development. JIT is an approach to part and materials inventory minimization and systems control that operates in conjunction with vendors, and Kan Ban is a similar approach to minimizing work-process inventory between manufacturing machine workstations.

The almost incidental effect of these approaches is to reduce the need for large inventory control information systems (i.e., because inventory size is dramatically reduced) and increase the need for more precise, accurate, and rapid inventory information to monitor the JIT and Kan Ban activities.

As a consequence, inventory information systems must be significantly modified and improved even though they usually will be monitoring smaller quantities of inventory; this will necessitate substantial IS/EI systems development activity. Additionally, JIT often relies on an extensive electronic data interchange (EDI) information system, which must be designed, implemented, and maintained as part of the QIP's continuous activities.

### **Business Process Reengineering**

For many companies and/or organizations, the impetus for BPR is advancement in IS/EI system capabilities. The relationship of IS/EI systems technology to BPR is a driving force for BPR projects or is an enabling force necessary for supporting some reengineered processes. Clearly, IS/EI plays a major and essential role in BPR, whereas it is only incidental or tangential to downsizing and QIP.

BPR involves first completely redesigning a business process, then searching for IS/EI system technologies that can support this radically new process. Although the study shows that not all reengineered business process require IS/EI systems support, Hammer and Champy are essentially correct in their view that for BPR, the information technology acts as an enabler that allows organizations to do work in radically ways.

This IS/EI technology as an enabler for BPR characteristics provides two major insights. The first is that most BPR projects ultimately involve building entirely new IS/EI systems for each process. Also, because reengineered processes tend to be simpler

than those they replaced, the new IS/EI systems also tend to be simpler (i.e., less massive, smaller capacities, and so on) than those they replace.

Next, although reengineered processes may require the use of only existing, well understood technologies, the occasion of designing an entirely new (and perhaps radically different) IS/EI system to support radically different processes does present the opportunity (and possibly the need) to search for new information technologies. Accordingly, an emerging technologies monitoring and analysis program may be useful in companies and/or organizations where BPR is used.

Finally, the study shows that IS/EI personnel tend not to be as involved in BPR as are line managers. This is understandable because the new systems should be built only after the new processes are designed. However, IS/EI systems personnel could serve their companies and/or organizations well by being routinely involved at the inception of every BPR project so that their analysis expertise can be of use in process redesign and so that they can have more lead time for searching for the most appropriate enabling IS/EI technologies.

## **Summary of Comparisons**

In “Appendix A. Summary Comparisons of QIP, BPR, and Downsizing,” I summarize much of the preceding information by presenting comparisons among the three approaches. Downsizing as portrayed herein is seen as a reaction to desperate circumstances on the part of a senior management that previously has neglected its management responsibilities, has encountered adverse economic circumstances or market shifts, or simply has been beaten by better competitors. Downsizing itself can be viewed as a form of neglect, because it is a panic act when a careful, considered, systematic approach to preserve the company by increasing its competitive position is what should be undertaken.

In addition, downsizing may receive only reluctant cooperation from lower levels of management, and it tends to create an “us-versus-them” attitude at all levels because everyone feels victimized by some level of managers above themselves. Even employees who cooperate fully to save their own jobs blame the debacle on higher management. The IS/EI systems technology environment is largely irrelevant to downsizing activities, except that a company and/or organization with well-developed IS/EI systems may be better able to withstand the negative consequences of downsizing.

Downsizing, however, does not usually occur in the pure form portrayed here. Often, simultaneous with the financial crisis, the company and/or organization puts in place corrective actions intended to deal with the underlying causes of business decline, but these measures may be window dressing or too little too late, or they will not become effective soon enough to fully offset the need to downsize.

Usually too, attrition mitigates the effect of downsizing somewhat so that a part of the downsizing is a hiring freeze to prevent replacement of departing personnel. These factors may reduce the negative effects of downsizing, but the fundamentals of the activity as discussed, and as shown in Appendix A, remain essentially the same.

Arguably, downsizing accrues for many companies and/or organizations because important reforms (e.g., those represented by QIP and BPR) were not initiated years earlier, or were unsuccessful, or have not yet become successful. Preferably, reductions in the number of employees, if this becomes necessary, should be the consequence of a

rational program such as QIP or BPR. Neither QIP nor BPR is intended to be used for reducing head count; however, as noted, one result of the BPR is likely to be that reengineered processes require fewer personnel.

Because BPR is a program that radically redesigns processes one-by-one and thereby restructures a company and/or organization over a medium-term or long-term period, personnel decreases related to BPR are likely to be necessary decreases that genuinely and permanently decrease costs while simultaneously improving the effectiveness of a company's and/or organization's operations.

In addition, timely use of BPR may produce personnel reductions that are gradual enough either to be offset by normal company- and/or organization-wide attrition and retirement or to permit displaced employees to be relocated to other positions in the company and/or organizations. Thus, morale is maintained, and no downsizing program is necessary.

## Recommendations

Although the primary purpose of this document is to compare downsizing, QIP, and BPR, the preceding discussion permits several recommendations to be put forward. The first is that companies should make every effort to avoid downsizing, that is, to avoid rapid employee layoffs solely to effect cost savings. If layoffs seem to be in the company's and/or organization's future, immediate initiation of a vigorous BPR program may, at the least, help decide which positions should be eliminated. The restructuring from BPR may then enable the company and/or organization to carry on after the layoffs, as or more effectively, with fewer personnel. The need to restructure rather than only downsize has been addressed to provide a four-stage approach to a restructuring effort that also trims unneeded personnel.

BPR is a moderately rapid approach to making a company organizationally lean and mean. To be fully effective, however, BPR must be initiated well before a financial crisis to be able to forestall the need for downsizing, perhaps as long as three years before the time of crisis otherwise would arrive. Companies and/or organizations of today should have the foresight to implement BPR now, so that those employees are never hired who otherwise would be laid off two or three years from now. The best way to deal with "bloat" is to prevent it, not cure it.

A BPR strategy can be undertaken solely on their own merits, and the payoff from BPR appears high. In addition, however, BPR can make organizations more fertile for QIP if it is implemented before or concurrently with QIP. BPR and QIP are not competing approaches, they are complementary and can be used together. Hammer tells us with respect to TQM and process reengineering that they are complementary; that is, *reengineering is about radical change, and TQM is about gradual, incremental change*. It appears to be easier and faster to achieve success at redesigning a particular process than to implement QIP, and success with BPR will improve the likelihood of success with QIP.

BPR programs should adopt certain of the QIP techniques. The QIP tenet of continuous improvement, if adopted as part of BPR even in those organizations not using a QIP, would mean that once a process is reengineered, it is then more-or-less continuously reviewed with the intent of further improvement. To this time, there has been no BPR emphasis on continuous improvement of a process.

Certain of the more specific QIP techniques also could assist with BPR. One notable example is benchmarking, which can be used to benchmark processes of other companies and/or organizations to help establish a replacement process.

Organizations with a QIP also could incorporate certain features of BPR into their QIP. One of the most promising is process redesign itself. Prior reengineering of the process is likely to provide an entirely new, radically different and much better process which can then be continuously improved within the overall QIP framework. QIP activities could then invent and implement entirely new processes rather than only stressing understanding and improving existing processes.

Another feature of BPR with potential as a part of QIP is BPR's emphasis on using IS/EI systems technology. An explicit focus within a QIP is on how IS/EI systems technology can be used to increase customer satisfaction and a better product and service quality.

## **Business Process Review and Quality Improvement Programs Summary**

This portion of the document presents definitions of downsizing, business process reengineering (BPR), and quality improvement programs (QIPs) that distinguish carefully the attributes of each. The distinctions made are useful in establishing an understanding of these concepts and activities and provide ways to think about and evaluate the desirability of each for a company and/or organization. At the same time, it is acknowledged that these distinctions are not and should not necessarily be maintained in practice.

The nature, purpose, focus, impact on a company and/or organization, costs, benefits, and other attributes of each are examined in a comparative fashion. The overall conclusions reached are that downsizing is a panic response to financial exigency that tends to destroy company and/or organizational values, capabilities, and employee loyalty; that BPR is a valuable, medium-range, project-by-project approach to restructuring an organization to make organizational processes more efficient and more effective; and that *QIP is a long-term activity that focuses on quality and on customer satisfaction improvements and beneficially impacts an organization's culture and value system.*

The financial impact of downsizing may be an immediate cost saving, but perhaps at the cost of longer-term profitability. BPR can provide benefits as each project is completed, and the benefits of QIP may be extensive but are delayed. QIP tends to impact both market position and profitability, but only in the long run.

The ill-effects of a downsizing program can be mitigated somewhat if BPR occurs concurrently. QIP activities can benefit by incorporating certain aspects of BPR and vice-versa. QIP and BPR are complementary activities.

IS/EI systems technology is seen as usually playing only a tangential role in downsizing activities. In QIP programs, the IS/EI systems technology role is vital but usually incidental and routine. IS/EI systems are likely to evolve along with the processes and other improvements associated with increasing quality and customer service on a continuous improvement basis. For BPR, however, IS/EI systems technology is seen to be critical as the enabler of radically new, reinvented processes. IS/EI systems personnel should become more deeply involved with BPR because of IS/EI's critical role in BPR.

The impact of each of the three phenomena on IS/EI technologists is different. For downsizing, the technologist may be called upon in advance or after the fact of downsizing to initiate or accelerate the development of new IS/EI systems that will enable an organization to operate effectively with fewer personnel. Alternatively, downsizing may eliminate vital IS/EI systems personnel and diminish the ability of the IS/EI systems technology group to serve the company and/or organization.

With respect to a QIP, the message to IS/EI systems technologies seems clear. *A QIP program should be viewed as an opportunity to demonstrate how IT/EI systems can play a more important role in improving product and service quality.*

The message is different for BPR. With BPR, IS/EI systems technologists will almost inevitably become involved. However, available evidence indicates that this involvement may be solicited too late to permit the IS/EI systems personnel to participate. What is necessary is for the IS/EI systems technologists to acquire a solid grasp on the philosophy and methodologies of BPR and “buy-in” completely to the need for BPR, then become advocates and sponsors of BPR; they should also participate from the beginning in BPR planning and as members of BPR project teams.

## **Strategic Planning: A New Dimension**

By identifying the core missions in a high-tech IS/EI systems technology research and development (R&D) organization, you immediately begin to understand the kinds of issues on which you must focus. In using the concept of the core mission, classical planning approaches are not discarded but rather modified by adding the concept of core mission. In particular, new planning concepts such as critical success factors (CSFs), total quality management (TQM), gap analysis, and key competencies analysis can be integrated tightly into core mission approaches.

In high-tech R&D organizations, IS/EI systems technology strategic planning has sometimes been viewed as irrelevant to their business. This is because the planning typically has been academic and technically oriented in nature. Classical planning approaches ignore diversity and organizational factors. These factors, however, are crucial in devising a meaningful and relevant plan for IS/EI systems technology, and it is necessary to make it relevant to the high-tech R&D business needs. This portion of this document introduces the concept of the core mission to IS/EI systems technology planning in a high-tech R&D environment. It categorizes the core mission and shows you how understanding the core mission of a high-tech R&D organization can lead IS/EI systems technology planning in the right direction to ensure relevance to business needs and goals in a high-tech research and development environment.

## **The Dynamism Issue**

Dynamism is the fundamental issue in strategic planning for high-tech IS/EI systems technology. These types of computer systems are becoming larger, the cost of failure is higher, cycle time of experiments and advanced technology is decreasing, and technological change is increasing at a very rapid pace. In the midst of all of these changes, IS/EI systems technology must still keep current systems operating, continuously enhance them, and decide how to cope with the many paradigm shifts taking place in the business and advanced technological spheres.

The types of change IS/EI systems technology must cope with are both business- and technology-based. Both business and high-technology goals are experiencing new emphases.

Picture a triangle that is the high-tech IS/EI systems R&D environment, i.e., the glue that holds everything together. The ideas, approaches, styles, and objectives are constantly changing, especially in the high-tech R&D organization. All these changes affect IS/EI systems technology, ranging from application goals, and design skills to relationships between applications and relationships with users and with organizational executives.

It is important to realize that IS/EI systems must have quality metrics built into the design stage of an application because that is what is required from the business and engineering end. An IS/EI system cannot expect to ignore the issues, or even expect that it can retrofit them into current and future applications.

Similarly, technological goals are changing. This affects not only IS/EI systems technology, but also, in turn, the business areas that may need to change their business models and processes as a result of new opportunities presented by these technological advances and changed emphases.

The fundamental problem for IS/EI is that all of these changing business and technological goals must be incorporated into its plans if it is to respond to real world (i.e., high-tech research and development) needs. With limited resources, the high-tech IS/EI systems technology organization must assign priority to where it expends its resources. How does high-tech research and development environments choose from these many areas and choices? If it chooses incorrectly, its influence will diminish and, worse, the organization will suffer. However, choices made may well be incorrect. What process can it adopt to ensure that it chooses correctly? The answer lies in the concept of the core mission.

## **The Core Mission**

The theory behind the concept of the core mission is that all high-tech R&D organizations focus on a core group of goals. These goals are determined by several factors, including history, a concept of mission, ideology, leadership type, and culture. High-tech R&D organizations do have a core mission. In fact, the Lawrence Livermore National Laboratory (LLNL) has basically three core mission areas: national security, energy and environment, and bio-sciences.

The core mission is usually implicit, however, and often does not line up with the explicit mission. An analogy in the political sphere is that a politician cannot be judged by what he or she says, but by his or her actions only. In the high-tech R&D sphere, this is known as the doctrine of revealed preferences (i.e., what employees want can be judged only by what they actually choose, not by what they say they would choose).

There are four major types of core mission that exist at LLNL and that are at the center of the mission triangle that supports the mission of LLNL. They are:

- Innovation.
- Quality.
- Environment.
- Growth.

These should not be regarded as mutually exclusive to LLNL, but as four poles (e.g., north, south, east, and west) where the core missions of a high-tech R&D organization

may at any point be bounded by the mission diamond. Nor does the core mission exclude the possibility of multiple goals; rather, it focuses on the weighting of various goals and on diversity preferences among them.

A large high-tech R&D organization can also have multiple core missions, as in the case of the DOE National Laboratories (e.g., Lawrence Livermore National Laboratory, Los Alamos National Laboratory, Sandia National Laboratories, etc.), or as in the case of several subsidiaries or divisions of a larger company and/or organization. The core mission is a construct that assists in identifying the main diverse (e.g., cultural) direction preferred by an organization.

### **Innovation**

The core mission of innovation is to create new products and services. The emphasis is on research and development. The culture is research driven. The focus is on revolution rather than evolution, on differentiation rather than evolution. Differentiation comes from product and service innovation. The CEO or Director is often a scientist and/or researcher who sets the major thrust areas of an organization.

### **Quality**

The quality core mission is to produce high-quality research through engineering and constant improvements. The culture is engineering- and/or scientist-driven and evolutionary. Differentiation is achieved through product quality and performance rather than newness. The CEO or Director is often an engineer and/or scientist. These organizations often end up producing excellent research and products that may become technically obsolete.

### **Transfer of Information**

The transfer of IS/EI systems technology core mission has as its main goal the maximization of sharing of that information. Emphasis is on the transfer of IS/EI internally and externally to the organizational clients. Differentiation is achieved through attention to the internal and external customer and service.

### **Growth**

The growth core mission is to build a large organization, particularly through diversification, often in several different areas of expertise. Such core missions are typically found in conglomerates. Because the organization may operate in different areas of expertise, someone and/or a group can be expert(s) in control, and the culture tends to be experimental and design driven. In the high-tech R&D environment, there are definitely experts in the various areas of research.

In each different type of company and/or organization, the prevailing culture selects the core mission from many different alternatives. The core mission then guides business and/or research choices. It determines strategies in all parts of the company and/or organization. For example, it provides the implicit criteria for hiring and dismissing. It produces a cadre of similar-thinking people that in turn reinforces the core mission.

Therefore, priorities for resources in an innovative organization tend to favor R&D of new technology or products, as opposed to expanding the transfer of information. In an engineering organization, there will be a preferential shift towards the



improvement of communication and the transfer of information. Each of the core missions shifts resources in favor of reinforcing itself (e.g., IS/EI systems technology).

To be relevant to an organization, plans and strategies must take the core mission into an integral account. In so doing, the plans take into account the particular cultural and organizational factors and preferences in the organization, e.g., high-tech IS/EI systems technology development for the future.

### **Core Mission and IS/EI Strategy**

IS/EI strategies and plans, like those of the other divisions in any organization, must be consistent with, and promote, the core mission of the organization. The priorities of the IS/EI system must match the cultural priorities of the organization in its strategic planning. The core mission of the organization will also dictate the types of people, skills, processes, and applications needed in IS/EI systems technology. Simply put, the IS/EI systems technology mission is to treat a company and/or organization of which it forms a part of the overall picture the same as the outside world.

IS/EI systems therefore strive to situate themselves roughly at the point on the mission diamond occupied by its host organization. Therefore, IS/EI systems can be seen to have four polar missions (analogous to those of the organization):

- Innovation.
- Systems quality.
- Planning and control.
- Different areas of expertise.

Each of the four IS/EI systems missions corresponds to a particular type of business or technology focus:

- Different areas of expertise corresponding to contemporary transfer of information goals.
- Planning and control of traditional goals.
- Quality to meet classical or production/high-tech R&D research goals.
- Innovation to meet the avant-garde goals.

In attempting to answer the question as to where high-tech IS/EI systems technology should focus, the list of four items can be used as a starting point. It will help you decide what types of strategies IS/EI systems technology should follow given the different core missions of the host organization.

Innovative organizations focus on the front end of the supply train (e.g., on invention, design, creation, and development of the IS/EI systems process). They tend to be weak at the back end in such areas as enhancement, transfer of information, and operational efficiency. The organization of the IS/EI systems in such groups would benefit from focusing on such areas as formal, creative needs finding processes, and new product creation and planning. Normally, their application focus may be in such areas as building R&D data repositories and/or warehouses, on enhanced communications between researchers and/or engineering, and on shareware, to enhance communication and creativity.

Quality-oriented companies and/or organizations focus on enhancement and continuous improvement. In such organizations, the process focus is on formal software quality assurance, formal metrics of quality, formal testing methodologies, and defect metric programs, both IS/EI technologies and in the production and service areas. The application focus is likely to be on production systems, particularly in organizations using computer-aided manufacturing (CAM). The technology focus is likely to be the

classical or production focus (i.e., it is unlikely to be leading-edge or too old to provide the quality desired by the engineering culture).

The planning and control core mission is interested in the cost of the entire chain. In their processes focus, IS/EI organizations must concentrate on formal measurement systems for IS/EI systems technology costs and productivity and on formal standards for resource allocation. Such organizations will be impressed by the development of a planning and control systems architecture and by methods for cheaper and quicker development. In their application focus, these organizations will focus on IS/EI systems technology for executive information, engineering data, and communications, the lifeblood of such control-oriented organizations. The technology focus here is on tradition or efficiency; those organizations are not willing to be leading edge unless an overwhelming, short-term advantage can be shown.

The IS/EI systems technologies require different areas of expertise. The core mission includes, but is not limited to, formal standards for user service, formal measurement of user and customer satisfaction, formal presentation standards for ease of use, formal disaster recovery standards, and measurement and improved systems responsiveness.

The application focus should be on the transfer of information and the different areas of artificial intelligence (AI) systems, and customer/client response systems. The technology will focus on traditional and contemporary areas, oriented toward the customer/client rather than the developer or producer.

The assessment of such strategies makes only generic suggestions. The precise mix of strategies must be tailored to the particular circumstances of the organization, taking into account its core mission and the level of maturity of the organization. The suggestions provided in this paper, however, are examples of the truism that if the precise strategies are not tailored to the core mission, IS/EI systems may be seen as out of step with the organization.

## **Formulating the Core Mission: Correct Strategy**

In the high-tech R&D environment, the approach of using the core mission allows classical planning methods to be modified to allow planners to control the two key issues: dynamism in the environment and diverse cultures within the organization. New strategic planning approaches have emerged, however, and they should be viewed together with the core mission approach.

Over the past several years, four new entrants to strategic planning methods have emerged. All derive from non-IS/EI technology areas and are therefore being increasingly used in an effort to more closely align the goals of business, science and engineering, and IS/EI systems technology. These are:

- Critical success factors (CSF).
- Total quality management (TQM).
- Key competencies analysis.
- Gap analysis.

### **Critical Success Factors**

This is an important planning tool. By examining those factors on which the business success of high-tech R&D critically depends, management can focus scarce resources for maximum impact. Nonetheless, CSF analysis has flaws. The principal problem is that many CSFs may be identified, all of which appear to be important, but only some of which are important seen from the viewpoint of the way the organization views the world.

It is here that the core mission approach can be crucial in identifying which of the many CSFs are important to that particular organization and the way in which they should be pursued. By more closely aligning CSFs with the cultural preferences of the organization, their number can be reduced, the most important ones identified, and the potential for success correspondingly increased.

### **Total Quality Management**

Although TQM has been popular in recent years, its efficacy has been rightly and widely questioned. Much of this stems from the fact that TQM is typically applied without regard to the particular core mission of the organization, so that inappropriate implementations are prescribed; this leads to frequent failure and loss of credibility.

TQM takes as its aim the application of process methods to all areas of the supply chain, including production, planning, and customer/client processes. It is clear that the core mission relates to four points along the supply chain and that what is regarded as a core mission simply represents the propensity of an organization to have particular competencies in one part of the supply chain.

If no regard is paid to the core mission, it is easy for TQM to be applied to all parts of the chain, even parts that an organization is less interested in, and for TQM not to be applied at first to the parts of the supply chain in which the organization is most interested. The core mission approach tells executives and senior management that, in introducing TQM, they should look at the core mission, and apply TQM first to those parts of the supply chain in which the organization has most interest. This maximizes the perceived payoff and increases the potential internal support for the TQM process.

One significant implication of this is in the IS/EI systems technology area; that is, armed with this core mission approach, IS/EI systems technology can unbundle the development life cycle and focus TQM efforts on those parts of the life cycle having the most cultural significance. Too often, a life-cycle approach fails because too much is required of the organization at one time in introducing it. The core mission approach, thus applied, allows executives and senior management to cope with constraints on a company and/or organizational learning. Because IS/EI systems technology is in a constant battle to implement some sort of developmental approach and standards, this becomes an important issue.

Typically, in most organizations, quality assurance, TQM, strategic quality planning, and strategic planning are all carried out as different processes by different units within the same IS/EI organization. TQM should be regarded as part of the strategic planning process, as should strategic quality planning. In addition, quality assurance, usually regarded as an organizational orphan, should also be tightly linked into these activities.

### **Key Competencies Analysis**

Key competencies analysis has become more popular in recent years. It is easy to identify key competencies in isolation, however, without regard to what the organization is really interested in achieving. Core mission approaches allow competencies to be identified that overlap with the core mission of a company and/or organization.

### **Gap Analysis**

Gap analysis has been practiced for many years. In its usual form, it identifies the gaps in technical skills in an IS/EI systems technology environment that are required to be filled for a company and/or organization to achieve its technical goals. This is too narrow a focus; the real effort should be in identifying gaps in systems, technology, skills, and processes relative to the core mission.

In summary, the core mission approach does not have to be applied in isolation from classical contemporary strategic planning approaches. It can and should be used as a template for these approaches, to filter out those issues of most importance to the organization. In so doing, it can act as a short-cut strategic approach, to be used as a quick credibility check on the results of more conventional approaches.

### **Dealing With Changing Core Missions**

Even where a core mission is constant, many employees may not understand what it is, or may not look behind the organization's rhetoric to decide what is really important to it. Organizations constantly have staff turnover at all levels, so even if some people understand the core mission, new employees may not. Very often, an organization may not be introspective enough to know what its core mission really is, even though it has one. In all of these cases, it is important to identify the core mission as a key component of strategic planning, not only for the IS/EI systems technologies, but for all parts of the company and/or organization.

More interesting is the case where the core mission changes. This may occur in a variety of ways (e.g., merger, acquisition, divestiture, change of CEO or board, change of management, or an unusual or abrupt shift in the company and/or organization precipitated by massive change in its environment). These events occur continuously,

but it is rare for most members of an organization to realize the implication: an abrupt change in core mission may have occurred that invalidates many of the assumptions on which planning was previously based. Although change is accelerating, there is often failure to see this type of transformation either by employees at the working level or, just as easily, by senior management. Changes in the core mission, however, can be life and death issues in the high-tech R&D environment or marketplace, and concern matters of corporate, individual and professional survival.

Neither high-tech R&D organizations, corporations, their managements, senior executives, or workers themselves can afford to ignore such changes. In the IS/EI systems technology environment, where technology changes at high rates, this compounds all of the usual business factors, and the issues even become more acute. All participants must constantly look to whether the core mission has changed as the key input to their strategic planning.

In many organizations, the leadership of IS/EI systems technology is a revolving door. The initial problem may well be that IS/EI systems technology has no concept, let alone understanding of, the core mission; that leads to the inevitable. A lack of understanding on the part of IS/EI systems technology, however, probably reflects a lack of understanding also on the part of executive and senior management.

To the extent that there is a lack of understanding on both sides, the issue is ultimately one of process. Unless a process is put into place to educate both sides (i.e., management and employees) and to ensure that there is a means of continuous education and communication, the problem will continue to add to the overall detriment of the company and/or organization.

Much of the problem in the IS/EI systems technology in a high-tech R&D environment may in fact may reflect wider problems in the organization. The concept of the core mission can be of major benefit to IS/EI systems technology in countering its lack of understanding, but by itself it may do little to solve the wider problem. The concept of the core mission will be most useful only in the context of an organization-wide process for sharing knowledge concerning the core mission and changes in it, and for ensuring that all members of the organization share knowledge to maximize the efficiency of its strategic planning efforts.

## **Continuity and Growth: Obstacles to High-Tech Reengineering**

The Galvin Commission Report is driving the National Laboratories to rethink their organizational structures and the processes by which they are managed. The necessity to be customer-driven implies a fundamental transformation of the way organizations are run. The benefits to be realized from reengineering are great; however, the transition can be tricky and must be effectively managed. This part of this paper identifies generic obstacles to efforts to reengineer high-tech R&D IS/EI systems technology processes. On the basis of theory and experience, it further suggests management principles that should be used to overcome obstacles and successfully redesign a high-tech environment.

## **The What and Why of Process Engineering**

The past two decades have been riddled with rapid innovations in the IS/EI systems technology (i.e., in both business and engineering). These innovations have brought about reductions in the time and costs involved in storing, processing, and communicating information. Aside from using technology as an automating or mechanizing force, IS/EI systems technology can be used to fundamentally reshape the way business and engineering are being conducted. IS/EI systems technology solutions that are implemented should support innovation, quality, and flexibility. These have become the necessary ingredients of business success as opposed to the traditional drivers of cost, control, and growth. Business and engineering processes as defined are a set of logically related tasks performed to achieve a defined business outcome. As business and engineering activities (i.e., processes) become more interdependent, it can be an especially useful tool in enabling the effective management of their interdependence.

For example, some high-tech firms are using EDI to coordinate activities with supplies and customers. In addition, leading global computer organizations have designed the advanced IS/EI systems technology using modern-day, flexible manufacturing concepts.

Efforts to automate existing business and engineering processes induced using IS/EI systems technology have failed to reap expected benefits, as documented by practitioner literature, consultants, and academicians. In general, the lack of organizational adaptation to the introduction of IS/EI solutions has resulted in automation of the status quo. High-tech R&D organizations now have an opportunity, however, to deploy the capabilities of such technologies as EDI and distributed database technology in conjunction with the redesign of underlying business and engineering processes.

Experience suggests that the results associated with investments in IS/EI systems technologies are strongly related to an organization's ability to revamp traditional processes given the capabilities of modern-day IS/EI systems technologies. This calls for a careful analysis and design of work-flows and processes within and between organizations given the capabilities of IS/EI computer technologies. *This approach to designing organizational systems is being referred to as the new, high-tech business and engineering paradigm.*

## Obstacles to High-Tech Process Reengineering

Reengineering in any environment does not just happen, especially in a high-technology environment. It is hampered by many obstacles, including, but not limited to the inability to:

- Reconceptualize the processes.
- Dealing with individual work designs.
- Work with hierarchical decision making processes.
- Work in an environment that lack the recognition of benefits.
- Deal with standalone "islands of automation."
- A lack of a development methodology.

These obstacles are discussed in the following sections of this paper.

### Inability to Reconceptualize High-Tech Processes

Reengineering in the high-tech R&D environment implies designing new organizational forms to achieve desired goals. This calls for creatively thinking individuals who bring multiple perspectives to bear. Individuals often represent localized expertise but have a limited understanding of the overall process.

In addition, most individuals are limited in their ability to reconceptualize processes because they are not familiar with the capabilities of emergent information and engineering technologies. In the IS/EI high-tech R&D environment, everybody has individual ideas as to how and what should be done.

### Individual Work Designs

Work designs created during the Taylor era abound in contemporary organizations. These types of individuals still tend to be evaluated on individual performance.

*Successful high-tech process redesign hinges on the ability of organizations to build teams of employees with cross-functional skills.* This is increasingly important if process outputs are to meet requirements from multiple perspectives.

Transformation to a high-tech approach requires cooperation from managers and employees across multiple functional areas at multiple levels of a high-tech R&D organization. *Cross-functional cooperation is not the cultural norm in most organizations.* However, there is a strong vociferation which is calling for fundamental changes in many organizations throughout the corporate environments. The issue in a R&D organization is that everybody has individual ideas as to how it should be done. You will not find a nice, neat standard that will solve the issue of high-tech IS/EI systems in the R&D environment. Cultural transformation is clearly a difficult endeavor because an organization's culture has been embedded in the everyday work lives of its management and employees for many years.

The corporate cultures of the DOE National Laboratories are built on a multifunctional mentality that greatly increases the difficulty of building effective, cross-functional, high-tech teams. In the high-tech R&D environment, cross-fertilization is the name of the game. It has served the Laboratories in the past, with highly technical products as the results. In a modified version, it will continue to serve this nation.

## **Hierarchical Decision Making**

It has been suggested that people closest to a process are often in an ideal position to make effective recommendations concerning solutions to problems emanating from activities surrounding the process. Process redesign should then push decision making down to the work-flow level where lower levels of management and line employees, who best understand the process, become more involved in critical decision making. Flatter organizational structures with broader spans of control are ideal mechanisms for enhancing the high-tech IS/EI systems technology reengineering effort.

Cultural transformation is clearly a difficult endeavor because an organization's culture has been embedded in the everyday work lives of its employees for many years. *The cultures of the DOE National Laboratories are built on a R&D mentality that greatly increases the difficulty of building the effective, cross-functional teams necessary for high-tech IS/EI systems.*

Solutions that do away with layers of management are politically sticky and hard to sell, especially to those affected. Managers currently in charge of a process are unlikely to willingly support radical restructuring of any kind. Loss of authority and shifts in power balance are likely to intensify political strife and resistance.

## **Lack of Recognition of High-Tech Benefits**

A bottom-line philosophy typically guides investments in information and engineering technology. Reengineering can result in a higher level of customer orientation, however, and lead to increased organizational responsiveness. Such benefits as client satisfaction, time-to-completion of R&D projects (or market), time-to-service, logical consolidation of human resources, and the effective management of dispersed, interdependent tasks are often not considered. These comprise the basis of competition and the objectives of high-tech IS/EI systems R&D reengineering efforts.

## **Standalone Islands of High-Tech R&D Automation**

Traditional processes were designed using centralized, standalone information and engineering technologies to support localized needs. Control of local activities rather than coordination of global activities has been the underlying rationale. Connectivity between such high-tech IS/EI systems is limited, and logical integration and interfaces are typically not planned in such cases. *These disintegrated systems can lead to fragmentation and inefficiency in processes.*

In a high-tech environment, both information and engineering management are becoming increasingly sensitive to the link between a well integrated IS/EI infrastructure and their ability to deliver effective business and engineering systems. *The logical integration of business and engineering systems (or lack of it) has a definite impact on any high-tech IS/EI systems R&D process reengineering effort.*

## **Lack of a Development Methodology**

The *three key elements* of a modern-day, high-tech information and engineering architecture include data, processes, and communication. Most organizations, however, have not adopted a methodology for developing their organizational information and engineering architecture. As a result, the interaction between organizational data, business processes, and communication systems is suboptimal and leads to inefficient and ineffective high-tech business and engineering systems.



## **Practical Guide to Process Reengineering**

Several years ago, I was involved in an in-depth study to identify what leads to successful reengineering. In fact, I was involved with this study before anybody knew what reengineering meant. Ten large- to medium-sized firms were studied extensively, and multiple perspectives were solicited from each firm to gain a better understanding of the essence of reengineering. Below is a summary of a series of practical guidelines for process reengineering that emerged from this study. The prerequisites were:

- Absolute executive and senior management commitment must be secured.
- A project champion with a good grounding in reengineering projects was to be recruited.

The steps involved were as follows:

- Mechanisms to integrate the IS/EI systems functions with the rest of the organization must be built, so as to:
  - Lead to awareness of IS/EI systems technologies induced process reengineering.
  - Facilitate support for IS/EI systems that encourage process reengineering.
  - Make the IS/EI systems function as part of the management process of the organization.
- Environmental scanning and benchmarking should be used to foster continuous improvement.
- Management should subscribe to a development methodology. Tools should be used only in conjunction with the chosen methodology. The methodology for development of high-tech IS/EI systems is known as the “spiral methodology.” This is discussed in my paper entitled, “Data Warehouse and System Design: How to Avoid A Disaster.” In addition, this methodology is discussed in my presentation entitled, “LLNL Geographical Information System/Spatial Data Initiative.”
- The right pilot project should be identified. This pilot project should as a minimum:
  - Identify processes involved (i.e., one of many).
  - Include the functional areas involved.
  - Identify the users impacted.
- Key players impacted by the high-tech IS/EI systems R&D reengineering effort should be identified and invited to put this effort in place.
- A team of skilled, cross-functional workers to be part of the reconceptualization must be built.
- Rapid organizational prototypes of modified processes should be developed.

- Metrics to gauge process efficiency and effectiveness should be implemented, with an emphasis on:
  - Quality.
  - Product satisfaction.
  - Cycle time analysis.
- A value-added (as opposed to bottom-line justification) approach should be employed.

The faithfulness of these principles emerged both in cases where reengineering efforts were successful (and these steps had been followed) and where efforts failed (and these steps either were not or could not be followed).

### **Political Sponsorship and Persuasive Championship**

Implementing IS/EI-based business and engineering solutions involves overcoming political, economic, and organizational risks associated with change. Political and material sponsorship necessary to change organizational structures, power centers, and job roles often require executive and senior management support.

Therefore, champions should be bearers of persuasive and evaluative information about an innovation. The high-tech IS/EI system reengineering process may require substantial organizational change and support from top management. This is an essential prerequisite, the absence of which is a clear prescription for failure.

### **Integration of the Information and Engineering Function**

Process reengineering is by definition cross-functional. The traditional command and functional control orientation of organizations is a definite inhibitor of the high-tech IS/EI systems reengineering efforts. The IS/EI systems function can serve as a glue to bring together different parts of the organization. Executive management should develop such innovative strategies as involving senior and line managers from different cross-functional areas to be on steering committees, and design empowered work teams with members from within and outside of the information and engineering organization.

### **Environmental Scanning and Benchmarking**

Scanning the environment provides a mechanism to benchmark business and engineering process characteristics. It is advocated as an essential strategy to ensure continuous improvement of critical processes. Such scanning efforts should result in the development of creative alternatives on how high-tech IS/EI systems solutions can be implemented to reengineer business and engineering processes. Informal associations with colleagues both inside and outside the DOE National Laboratories, other firms and organizations, industry newsletters, conferences, seminars, continuing education classes, and group meetings are mechanisms that could be employed. It is important to remember that the nature of environmental scanning should embody both a business and engineering focus.

## **Process Reconceptualization**

User involvement has been often cited as a key ingredient for system success. People closest to the process are sometimes the most familiar with underlying deficiencies. Both intra- and inter-organizational activities require involvement from users across traditional organizational boundaries. Users from different IS/EI functional areas throughout the R&D environment (i.e., internally and externally to the Laboratories) and consultants should be brought together. Involvement of only a subset of users will lead to a narrow perspective on the limitations and potential benefits of the present process. Some organizations are using cross-functional (and inter-organizational), empowered teams to facilitate creative out-of-the-box thinking toward the redesign of IS/EI systems reengineering processes.

## **User Education**

It is important to inform the user community about the potential of emergent IS/EI systems technologies and their inherent capabilities. Such education could expand the nature of solutions considered and, in general, facilitate a supportive climate where users can be a constructive part of reconceptualizing the way IS/EI systems work processes are carried out. Organizations can use newsletters, electronic bulletin boards, and in-house seminars as plausible channels. The focus should clearly not be technology education *per se*; rather, emphasis should be placed on the possible business leverage of emergent technologies. These mechanisms will provide users with the essential knowledge necessary to reconceptualize business and engineering processes.

## **Organizational Prototyping/Adoption of a Methodology**

Processes should be prototyped. Reliance on a traditional system development approach minimizes user feedback and involvement. It is quick and easy to develop prototypes using the “spiral methodology” and the appropriate tools. It is cheaper to discard or revise a prototype using this methodology than to implement an ineffective IS/EI systems technology for an organization.

It is important to adopt a methodology that drives the IS/EI strategic plan. The methodology should be the basis for studying the nature of the interactions and relationships among data, processes, and communication systems. Organizations could either subscribe to a packaged methodology developed by a vendor or consultant, or develop one in-house. It is imperative that development tools be used in conjunction with a development methodology.

Several organizations, that I am aware of, have invested substantial amounts in the development tools, but in the absence of a well-defined methodology they saw no improvement in their IS/EI system process reengineering development efforts.

## **Measures of Efficiency and Effectiveness**

The Malcolm Baldrige award and the equivalent DOE Quality award are for total quality and emphasize management by fact. Most organizations, however, have paid little attention to the evaluation of processes; as a result they have not developed appropriate measures for gauging process performance. However, the quality revolution underscores process thinking. It is important that metrics be developed to gauge the efficiency and effectiveness of the business and engineering processes. Cycle-time analysis, behavior analysis of the users, and customer satisfaction are some metrics

that can serve as useful feedback to managers in gauging the quality of key business and engineering activities.

### **Justification of IT and EI Investments**

Methods for justifying IT/EI systems-based solutions have been receiving increasing attention by the DOE National Laboratories, as well as by organizations outside the Laboratories. However, it is increasingly recognized that investments in the strategic deployment of IT/EI cannot be justified on the basis of stringent return-on-investment (ROI) measures and short pay-back periods. Reengineering involves substantial costs in reconceptualizing processes and redesigning organizational structures and work flows. It is important to justify such systems based on their potential impact on customer/client satisfaction, quality, cycle time, and productivity rather than on a traditional, bottom-line perspective.

### **Information /Engineering Systems Summary**

The high-tech IS/EI systems R&D technology reengineering effort consists of two key challenges: reconceptualization and implementation. The first challenge requires the management and support of creativity. Employees at all levels should be organized into empowered teams to come up with alternatives to the status quo. The role of the manager changes from one of control to one of coordination.

Education, learning to learn, and a continuous improvement philosophy must be instilled as part of the cultural fabric to meet this challenge. Implementation requires overcoming political hurdles. Executive and senior management support and project champions can go a long way here.

From a systems perspective, organizations must subscribe to a development methodology. This will enable a systematic analysis of the data, process, and business system. It also mandates that subsystem relationships be considered, thereby enabling identification of synergies and overall system optimization. All in all, the high-tech IS/EI systems R&D technology reengineering implies a fundamental change in organizational design as traditionally heralded during the industrial age. A flexible organization (if and when it is reached) would change the notion of an organization from a noun to a verb!

### **Lethal Reengineering Mistakes**

The technical, management, and trade press are filled with articles on business process reengineering (BPR). Research finds BPR to be the leading improvement

program that executives and senior managers have undertaken, or are planning to undertake, to achieve the following objectives:

- Reengineering.
- Automation.
- Restructuring.
- Downsizing.
- Outsourcing.

BPR has become the program of choice for achieving business improvements in the 1990s. However, it has been estimated that four out of five reengineering projects are ultimately unsuccessful! Is BPR so inherently risky, or are people and companies and/or organizations making fatal mistakes in planning and executing their reengineering projects? An effort will be made to summarize results from experiences in implementing IS/EI systems technology in a high-tech research and development environment.

### **Business Process Reengineering and Popularity**

BPR is not new. What is new is the label and a systematic attempt to accomplish breakthrough performance within an organization. BPR has become popular for three reasons:

- First, the three-year global recession has proven to most high-tech R&D companies and/or organizations that the IS/EI systems technology (i.e., business practices) of the past are increasingly inadequate.
- Second, disappointment has increased regarding the ability of TQM to transform organizations.
- Third, BPR has been advocated by very articulate and entertaining managers throughout the IS/EI computer systems industry.

### **Why Reengineering Projects Fail**

There are nine fatal mistakes that cause reengineering projects to fail:

- Unclear definitions.
- Unrealistic expectations.
- Inadequate resources.
- Taking too long.
- Lack of sponsorship.
- Wrong.
- Techno-centralism.
- Mysticism.
- Lack of methodology.

Each fatal mistake will now be discussed in some detail.

#### ***Fatal Mistake Number One: Unclear Definitions***

BPR is not just reengineering automation, although it often uses technology in creative and innovative ways. BPR is not just downsizing, although it usually improved productivity. BPR is also not just quality, although it is almost always focused on customer satisfaction and on the processes that support it.

Rather, BPR is a balanced approach that may contain elements of these traditional improvement programs (with which it is often confused) and also with such others as

outsourcing, broad banding, and continuous improvements. However, BPR is more than this:

- First, BPR seeks breakthroughs in important measures of performance, rather than incremental improvements.
- Second, BPR concurrently pursues multi-faceted improvement goals such as quality, cost, flexibility, speed, accuracy, and customer satisfaction, and does this while the other programs either focus on fewer goals or trades off among them.

To accomplish these results, BPR adopts a process perspective of the business, while the other programs retain functional or organizational perspectives. (TQM does examine processes, but to improve them, not to reengineer them.) BPR also involves a willingness to rethink how work should be done, even to totally discarding current practices if that should prove necessary. Finally, BPR takes a holistic approach to business improvements, encompassing both the technical aspects of processes (e.g., technology, standards, procedures, systems, and controls) and the social aspects (e.g., organization, staffing, policies, jobs, career paths, and incentives). In other words, BPR leverages technology and empowers people.

The definition of BPR that I use is: *the rapid and radical redesign of strategic, value-added business process to optimize the work flows and productivity in any organization*. This includes systems, policies, and the organizational structures that support them.

### ***Fatal Mistake Number Two: Unrealistic Expectations***

Perhaps because of the unclear definitions of what BPR is, and perhaps because of over-enthusiastic promotion of BPR's benefits, many senior executives have unrealistic expectations of what a reengineering project can accomplish. My point is that BPR can produce performance breakthroughs (particularly if it involves a broad aggregate measure of performance such as profitability), while more traditional improvement programs produce only incremental gains.

A BPR project should certainly be undertaken with a willingness (even a hope) for order-of-magnitude gains. But goals should be set, and expectations conditioned, on the basis of realistic analysis performed during the project.

In addition to unrealistic expectations about the size of the gains from BPR, some executives are mistaken about the domain of its applicability. BPR is applicable to the operational level of a business; not the strategic or even the tactical. It can show you how to do things right, but can identify only in a limited way what are the right things to do. BPR will *not* identify the markets you should be in or the products you should develop. *But it can give you effective processes for making those decisions.*

### ***Fatal Mistake Number Three: Inadequate Resources***

As with many other organizational projects, BPR projects face the common dilemma that the people best suited to perform the work of the project are usually the ones who can least be spared from their normal duties. It helps to understand that there is no real solution to this problem, and that any accommodation will be a compromise.

Hiring consultants may be a beneficial idea, but they cannot replace your own people on the BPR project. *Employees bring to the reengineering team an understanding of current processes, key individuals, and culture that is difficult for an outsider to obtain. They also bring a personal stake in the project outcome.* Outsiders, whether they be consultants, employees from a different organization, or new hires, play an invaluable role in BPR. They bring a fresh perspective and the creative naiveté to ask: "Why do we do things

this way?" Consultants can play another role as well; they can bring methods for BPR and experience in doing a BPR project.

Therefore, the following are required to adequately research a BPR project:

- First, provide a balanced mix of insiders to outsiders (e.g., five or six to one) on the reengineering team.
- Second, give the people on the reengineering team enough time to do their work. Some of the people, who have attended reengineering seminars, have told me that their reengineering team assignments were for as little as 10% of their time! That's barely enough to account for the loss of productivity from switching tasks. Full-time assignments are probably neither feasible nor desirable at most companies, because you want team members to stay involved in the processes that they will be reengineering. But something on the order of half-time is necessary for meaningful contribution and progress.
- Third, ensure an adequate budget for the insiders' salaries, for the outsiders' fees, and for expenses. This should be self-evident, but nearly two-thirds (approximately 65%) of the companies that I have spoken with do not have budgets for programs like BPR.
- Fourth (and most importantly), it is often not enough to simply assign employees, send them to seminars, and turn them loose. They must be trained and supported. Overall, slightly more than half the companies (approximately 54%) are using outside resources to assist their BPR projects. Of those who are not using outside resources, the most common reason given (by approximately 70% of the executives surveyed) was: "We have the knowledge and expertise to handle the project in-house."

Interestingly, the larger the company, the more likely they are to use outside consultants (ranging from 43% for companies under \$100 million to 71% for companies over \$1 billion). This is just the opposite of what one would expect, because the larger companies should have more in-house knowledge and expertise. This is probably a case of the *larger companies' knowing what they don't know*.

Similarly, the percentage of executives who think they have the expertise in-house varies by their functional responsibilities, from a low of 56% for CIOs, directors, and general managers, to a high of 82% for CFOs. Here, too, this may show that the CIOs (who would be a lot closer to the BPR project) are more likely to know what they don't know.

### ***Fatal Mistake Number Four: Taking Too Long***

BPR practitioners believe that reengineering projects should take three to five years, yet few executives have that kind of patience. The question is: “How soon do you need to see results?” The results from a study I had done in 1994 were very interesting: 31% of the executives who responded reported needing results in six months or less, 54% said one year or less, 89% said two years or less, and 94% said three years or less.

To a certain extent, this reflects their pressing need for the performance improvements that BPR can bring. This could mean favoring low-risk projects with near-term payback over projects with more substantive returns, but it need not.

### ***Fatal Mistake Number Five: Lack of Sponsorship***

Meeting senior executives’ expectations for results (see Fatal Mistake No. 2) and their tolerance for delay (see Fatal Mistake No. 4) is certainly necessary to retain their sponsorship, as is satisfying their appetites for cost and risk, but one must obtain that sponsorship in the first place. Senior management must sponsor BPR for several reasons:

- First, the impact of BPR is so broad that only senior management can sanction it.
- Second, BPR usually involves a shift in culture, and it is uniquely senior management’s role to set the culture.
- Finally, BPR requires leadership of the most visible sort.

How does one obtain that sponsorship? An executive generally has to go through four stages before he or she will commit to sponsorship. They are:

- Awareness.
- Curiosity.
- Interest.
- Belief.

Most senior executives are already at the awareness or curiosity stages when they are involved with the BPR process. As of January 1994, 80% of the CEOs were familiar with BPR, and the numbers are certainly higher now. To move to the interest stage, an executive has to have two things:

- The first is credible evidence that BPR has worked for others.
- The second is recognition of a need that BPR might satisfy.

Organizations do not undertake BPR because it is trendy or because it is elegant. They do so (often as a last resort) because they need to. This need is, in my experience, driven by one of three things: pain, fear, or ambition. Organizations feeling pain (e.g., because of low profits, shrinking market share or shrinking budgets) have to do something now. Organizations feeling fear (e.g., because of aggressive competition, changing markets and/or being incorporated into another organization) have to do something soon. Organizations feeling ambition (e.g., because of expanding market share or entering new markets) have to do something now to realize their ambition soon. If an executive doesn’t feel need for BPR, he or she won’t be interested in it.

To convert that interest into belief, the executive must be convinced that BPR will help meet the need. One way of accomplishing this is by showing the executive a demonstrated success within the organization. Another way is by showing the executive exactly how you propose to carry out the BPR project. An example of this is my paper entitled “LLNL Geographical Information System Initiative.” This initiative is for all LLNL’s organizations; for it is not so much whether BPR can work, that he or she questions, but whether “we” can make it work.



### ***Fatal Mistake Number Six: Wrong Scope***

Sometimes you hear people say, “We’re reengineering the company,” or “We’re reengineering the department.” A seminar that I just attended is called “Reengineering the Information Services Organization.” And I am sure that you can add your own flavor of the month to these statements.

Actually, you cannot reengineer an organization; you can only reengineer its processes. And many processes are inter-organizational and cross-functional. In fact, one of the main ways that BPR improves performance is by reducing or eliminating the errors and inefficiencies that inevitably arise when processes cross organization boundaries. When the scope that is chosen for a BPR project is one that includes only part of a process, the opportunity for success is diminished.

By the same token, you need to select the right process to reengineer. Not all processes are equal in either importance or in their contribution to organizational goals. That is why successful BPR focuses on strategic, value-added processes. Strategic processes support the organization’s business strategy. Value-added processes are those that deliver value to the organization’s customers.

The question of scope is intimately connected with the question of sponsorship. In the ideal situation, the BPR project would be sponsored by the executive officers. In that case, the entire organization may be examined to find the most strategic and most value-adding processes to reengineer.

Sometimes, however, the sponsor is a business unit head, a general manager, a department head, or a division leader. In that case, the project scope must be made congruent with the sponsor’s span of effective influence, and the processes selected for reengineering should be the ones that are most strategic for the mission of the sponsor, most value-adding for the sponsor’s customers, and wholly (or mostly) within a defined scope.

### ***Fatal Mistake Number Seven: Techno-Centrism***

Another thing I’ve heard people say is “We’re reengineering; we’ve acquired image processing,” or “We’re reengineering; we’re moving to the client/server technology.” Again, you can add your monthly flavor to this.

Certainly technology is a key enabler of BPR. But technology is not BPR. *BPR changes the business processes, the way the work is accomplished.* Applying technology to current processes has been rightly called “paving the cow path.”

This mistake is often associated with Fatal Mistake No. 4. Although some technologies (e.g., desktop computers for personal productivity or mobile telephones) are quick and easy to install, technologies that support and enhance a process as a whole are often more complex and difficult to implement. By contrast, the social side of processes (i.e., empowerment) usually can be implemented faster, and often provides the majority of the benefits.

Many of the most successful BPR projects have been ones in which new technology was delayed to later phases. This is not to say that the social changes are easy, just that they are faster to implement. In fact, the opposite is true: the social change is almost always harder than the technical change. This is discussed in more detail in the section of this document entitled “Changing People and Changing the Organization.”

### ***Fatal Mistake Number Eight: Mysticism***

Inasmuch as BPR requires a willingness to rethink how business and engineering processes should be performed, there has been a lot of attention paid to the process of rethinking. For example, one may be a student of BPR who reads, hears, and even sees much about paradigm shifts, breaking frames, and out-of-the-box thinking. The trouble is, one can't shift paradigms; one can only experience a paradigm shift.

By the same token, some of the published materials on BPR could lead one to believe that BPR is entirely a creative act, requiring an intuitive jump or some kind of transcendental experience. This is simply not so. BPR is an engineering discipline, although a new one. It can be practiced by the average intelligent manager or business professional.

Just as the human potential movement of the 1970s taught many ordinary people how to transform their personal lives, BPR can enable people to transform their business lives. Although both movements sometimes use mystical terminology, both are based on a discipline and specific methods for achieving the breakthrough.

### ***Fatal Mistake Number Nine: Lack of an effective Methodology***

A BPR methodology provides the discipline and specific methods needed to break out of the old narrow way of thinking about the business, envision a better way, and realize that vision. For example, below is a methodology that consists of five stages:

- *Preparation.* Mobilize, organize, and energize the people who will perform the reengineering project.
- *Identification.* Develop a customer-oriented process model of the business you are looking at as a BPR project.
- *Vision.* Select the processes to reengineer and formulate redesign options capable of achieving breakthrough performance.
- *Solution.* Define the technical and social requirements for the new processes and develop detailed implementation plans.
- *Transformation.* Implement reengineering plans.

These five stages consist of 54 specific tasks that lead the reengineering team from original recognition to the need to reengineer all the way to obtaining the performance breakthrough. *A good methodology provides a road map for reengineering. In other words, it enables an organization to select the most appropriate destination, and then provides the best route to get there.*

There are many ways to use the methodology, and each organization will have to select the approach that best fits its need. Some will re-sequence or reassess the tasks, or omit some entirely. Others will adapt tasks to their own style and culture, which may mean adding some tasks.

Without a good BPR methodology, however, organizations are left with the "what" but not the "how to." Without a methodology, IS/EI systems reengineering projects run the risk of deteriorating into, on the one hand, brainstorming sessions and quality circles or, on the other hand, more of the same old automation or operations improvement projects.

## **Conclusion: Information/Engineering Systems Reengineering Projects**

IS/EI systems reengineering projects are no more risky than other types of organizational projects with similar ambitions. Indeed, BPR may be the only way, in the long run, to achieve really ambitious operational goals.

Failures in BPR projects have usually come from mistakes in defining, organizing, or conducting the project. To avoid these mistakes, follow the nine commandments of BPR:

1. Be clear.
2. Be realistic.
3. Be prepared.
4. Hurry up.
5. Have a champion.
6. Focus.
7. Technology yes, but people first.
8. Don't get snowed.
9. Follow a methodology.

## **Socio-technical Approach: Minimizing Chaos**

A growing awareness of the opportunities in reengineering recognizes it as an alternative to automating the chaos of many manufacturing and service work processes. Frustration is also building, however, over costly and disruptive reengineering efforts that in the end fail to produce any measurable improvements. It is apparent that successful reengineering requires a clearly thought out and tested methodology, preferably one with a track record of successes in a range of industries.

Business processes and the technologies that support them change. However, much has been learned about the way people interact with technology, no matter what that technology is. This body of knowledge should not be ignored by anyone contemplating business process reengineering. This portion of this paper examines another method of business process redesign that takes into account the interaction of human and technology.

Socio-technical systems (STS) is a structured, teachable, and participative method of business process redesign that has grown out of decades of studies on the interaction between people and technology in the workplace. It not only has a history of successes, but also is particularly well-suited to today's rapidly changing business environment.

Where does the STS method come from? And how can it be applied to information system (IS) and engineering information (IE) systems technology? To answer these questions, a review of history is in order.

### **Origin and History**

Models of management have been heavily influenced by the paradigms of the dominant technology of the period. In the machine age, the high priest was the steam engineer, the environment was placid, and the goal was operational reliability. Centralized structure was necessitated by the technology.

Functioning under the mechanistic rules of scientific management, industrial engineers divided production work into the smallest possible units; that is, each worker was trained to perform as efficiently as possible. But in the 1950s, this model of engineering and technology failed to live up to its promises; that is, increased

investment was no longer yielding proportional returns. This opened the door to systems thinking, and team-based management is one of the last innovations of early socio-technical research.

As STS research matured, it focused on the pursuit of purposeful organizations. This purposeful orientation was merely tolerated in the 1970s when the concept of mission was often considered irrelevant.

It was the end of the tranquil external environment that forced managers to look for new paradigms, because people are more adaptable than any technology. In today's environment, of course, adaptability and an understanding of mission are a necessity.

Information technology is unique in that it is the first inherently flexible technology. Ironically, by following the centralized, controlling paradigms of an earlier era it has frequently been used to enhance people's ability to be rigid. IS/EI systems have increased productivity by automating an organization's fragmented tasks. In doing so, however, IS/EI systems have actually encouraged the separation of workers from the organization's mission.

According to Professor James C. Taylor of the University of Southern California, an expert in work design and systems management, "when work is fragmented and standardized, workers lose all understanding of how that work contributes to company success or how mistakes confound it. That information becomes the exclusive concern of management."

Dr. Taylor says that STS is based on understanding "what business we're really in; and what joint optimization between social and technical requirements are needed to excel at that business." It is a management approach that can be applied to any work process in a manufacturing, service, or knowledge work organization.

### **Minimizing Chaos: How it Works**

In any technology, organizational choices are contained in the technical design. These are sometimes intentional and sometimes unintentional. The STS approach attempts to consciously and systematically integrate the technical (i.e., hardware and software) side of the organization with the social (i.e., customer interaction and satisfaction) side of the organization. In addition, these STSs are seen as both influenced by and able to act back on their environment.

Dr. Taylor describes the basic steps involved in implementing the STS methodology. STS is a participative process, that is, at each of the steps two through five in the STS process, feedback and dialogue will demand that preceding decisions be reconsidered and often changed.

#### ***Step One: The System Scan***

The first step in the STS approach is to create a shared vision of the organization. At its core, STS enables a focus on products rather than on tasks, combined with a view of the organization as a IS/EI system designed to create that product.

The IS/EI systems scan defines the general characteristics of an enterprise with purpose, values, characteristics, its basic input and output, and its environment. The IS/EI systems technology scan is crucial because it establishes a dialogue between managers and the rest of an organization.

A steering group of managers and employees should be brought together and asked to describe the organization in IS/EI systems terms. They are asked questions about their organizational mission, philosophy, and objectives. The managers and users are asked

to define their outputs and inputs and the characteristics of each and the boundaries between the organization, its suppliers, and its customers. They are also encouraged to compare their organizational objectives to their short-term goals and organizational characteristics.

Next, a redesign group is given the same task of describing the organization in IS/EI systems terms. This group does not usually include managers; instead, it tries to represent many aspects (e.g., supervisors, support, and IS/EI systems operations personnel) of the organization in terms of IS/EI systems technology.

### ***Step Two: Technical Systems Analysis***

The IS/EI systems technical systems analysis describes what happens to the organization's product as it passes through the system. It identifies the variances through the system. It identifies the variances that will occur at state changes in the IS/EI process. *State changes are those parts of the manufacturing or service process where the product is changed.* In contrast, steps like inspections, which are a part of nearly every manufacturing process, do not, in and of themselves, change the product.

Variances in the throughput are not necessarily items that go wrong; they are the normal occurrences that affect the quality, quantity, or cost of the product. The focus is on understanding normal IS/EI systems operation, given the system's mission or purpose, because by effectively addressing normal operations managers will both have the time to deal with problems when they occur and be less affected by them overall.

Thinking about variances and state changes substantially increases an organization's understanding of its own business processes and is one of the more powerful benefits of STS. Managers and employees often realize that they have never understood all the variances and changes that occur in a product or process, and they recognize that they have never talked about these issues.

Typically, 80 to 100 variances are identified. A final catalog of 8 or 10 key variances is selected from this list after the redesign group has flow-charted the organization's processes to determine which are most crucial. The original list is not discarded; over time, the remaining variances can and should be considered.

### ***Step Three: Key Variance Analysis***

Key variance analysis examines how the organizational IS/EI systems currently cope with or controls these key variances. The redesign group looks separately at each key variance. It asks where the variance occurs, where it is observed, and where it is controlled. Organizations that design themselves to control their main variances are successful; those that cannot control variances end up with unsatisfactory output.

The next set of questions concerns who controls the variance. The team asks what organizational roles are involved, what actions are taken, what information is used to guide that action, and where that information is obtained. By exploring these questions, a redesign team often discovers which variances are controlled haphazardly or illogically. Because key variances are examined before the IS/EI systems are improved, this examination also provides an effective performance benchmark against which to compare subsequent changes and improvements to the IS/EI systems.

After the key variances are analyzed, the redesign team's responsibility is to brainstorm, not implement, ideas as to whether the fixes are organizational and/or technological.

#### ***Step Four: Social Systems Analysis***

The social systems analysis examines who talks to whom about key variances, the organizational environment, and other long-term matters. The redesign team identifies the focal roles in an organization, that is, the most important people in the organization (i.e., formal and informal) with respect to control over the identified key variances. These are often not the people one would initially expect.

After the focal roles are identified, the team finds out who these people are in contact with about key variances, about changes in the external environment, and about the integration of the social organization. A unique set of benefits become apparent. Whereas other management models may maintain the physical and social happiness of employees, those models do not help employees understand the external environment of the competition.

The result of the social systems scan will be a grid revealing the frequency, direction, and purpose of contact between focal roles and other people.

#### ***Step Five: Redesign***

In this step, the new organizational IS/EI systems design is created and tested. Unlike the other steps, this is not a structured process. It is undertaken by a group large enough to represent a true slice of the organization, but small enough to be able to work together for several months.

The group members are encouraged to think. The question they may want to ask is: "If I were the king/queen here, how would I redesign the IS/EI systems." This constraint-free design technique should yield a jointly developed ideal organization. This process should be easy if the IS/EI systems team has carefully worked through the first four steps.

The constraint-free organizational IS/EI systems design is tested to see if it controls the key variances better than the existing organization. It is also tested for its ability to improve cooperation and coordination among work groups.

The constraints (e.g., money, time, or technological feasibility) are reintroduced, and the IS/EI systems design is tested against them and modified. It is then possible to build and justify a workable IS/EI system, including the associated technology to support it. Not only will information IS/EI systems technology support the organization, but also it will become the foundation for the workflow throughout the organization.

#### ***Socio-technical Systems and Step Analysis Summary***

IS/EI systems technology implementors and vendors typically attempt to understand a business, and uncover IS/EI systems technology opportunities, by exploring its problems. They then sell solutions to the users, the functional departments and/or divisions of the organization. The approach is focused entirely on tasks, frequently in isolation from other activities in the business. The existence of the term "user resistance" testifies to the fundamental weakness of this methodology.

A fundamental difference in the socio-technical system arises from its purpose, rather than its tasks. Within this context, the analysis of the technical and social subsystems reveals key variances that are opportunities for information technology implementation.

By looking at the activities of an organization in terms of the output (i.e., product) and how it is created and delivered, rather than as a complex collection of tasks, STS

allows the system to be seen on a human scale, which is to say an understandable scale. This understanding is what builds a shared vision in an organization.

## **Changing Organization and Changing People**

In the high-tech R&D environment of today, change is the norm, whether it be in the government or outside industry, and it will continue to be a major factor in running an organization as the coming decades unfold. The former cycle of change followed by stability is gone; change as a continuous reality is the new cycle. Organizations must change because survival makes recurrent change a basic need.

### **Ongoing Change**

Continuous improvement in the name of quality, productivity, and competitiveness requires ongoing change. This results in a very real fear overtaking many organizations and their employees that the changes are never over, and that other changes will soon occur. The key to adjusting involves learning to manage change as well as organizations formerly managed stability.

The requirements of meeting the demands of ongoing change are vast. To begin, the following four key questions must be answered:

- How can managers lead and guide the change and its inevitable reactions so as to minimize negative effects for both the employees and the organization?
- Are today's employees the right employees for tomorrow? If not, who is needed and what is needed to attract them?
- How can managers ensure they have the right employees prepared for tomorrow?
- How can managers help the organization learn to manage its ongoing changes so that the turmoil subsides despite the changing environment?

No change process occurs without pain, chaos, and recurrent fears of loss of control. Leaders must learn to recognize that change cannot happen without what they view as chaos, and what employees view as letting go. Paradoxically, chaos is not really chaotic if the leaders are guiding the change and focusing on the segments to be changed. Sometimes, however, it is stressful.

Leaders must guide change within the framework of a strategic direction that is healthy for the organization as a whole. Their responsibility is to the greater good of the organization and to ensuring the prosperity of the company. Morally and ethically, leaders must develop strategic directions that lead the organization to a niche that provides benefits for all corporate stakeholders. Once the strategic direction has been determined, then with equal diligence, thought, and participation, leaders must create a comprehensive plan for guided change. The plan should include a participative process that allows the employees to redesign and reengineer their work areas within the larger strategic framework.

### **Organizational Segments of Change**

To lead and guide change, a leader must understand the interlocking components of a high-tech R&D organization and learn how to guide that organization through the change process. Each organization has the following seven segments that make it unique:

Its—

- Genetic Core.
- Philosophy.
- Formal Organizational Structure.
- Information and Technology Systems.
- Normative Behaviors.
- Informal Organizational Structure.
- Culture.

These segments all interact with one another; a change in one influences all the others. Leaders in a high tech R&D environment can intervene in any or all of the segments to begin change. Ultimately, you will find that you must create change in each to create a new organizational balance.

All the segments must change so that the organization is in balance (i.e., all seven segments are in alignment and support each other). Like a jigsaw puzzle, high-tech R&D organizations must have all the segments interlocked and reinforcing each other.



## ***Genetic Core***

The genetic core evolves from the type of executive management that an organization has. They set the organization's strategic direction, created the operating philosophy of the organization, and (less consciously) set the standards for employees behavior, values, and beliefs. Over time, their interaction with the employees spread their values and beliefs to everyone in the organization. Consequently, their personalities become embedded in the culture of the organization.

Therefore, the genetic core of a high-tech R&D organization is creativity, entrepreneurial instincts and behaviors, and independence. The entrepreneur hires a management team that values these beliefs, and also has a bias toward the power of individual thinking. The employees internalize these particular types of values and beliefs, act on them, and shape the culture and philosophy of the organization.

As the employees learn the culture, they come to value displaying their actions in the best possible light, in emphasizing the positive, in the power of selling. Managers and employees alike emphasize creativity, are more interested in the presentation process than the subject, and believe that the abilities of the high-tech R&D environment is the most important aspect of success. Interpersonal behavior is always upbeat, risk taking is encouraged because of proven, past successes, and negative information is frowned on. Thus, the management of the organization becomes its genetic core, determining the personality of the organization, driving the values into the employees and management, and leaving a living legacy of values, behaviors, and beliefs.

At the genetic core of an organization are people who value reliability, logic, up-to-the-minute knowledge, precision, and low-key personal and professional behavior (i.e., people can speak up and present their ideas without feeling that they will be humiliated in front of their peers and management). This organization's employees believe that precision is the key to success, that decisions should be made carefully, rationally, and fairly. Everyone emphasizes facts and intuition, proven outcomes and risk, and thinking out loud and discussing their thoughts.

Interpersonal behavior is respectful, judgments are based on the expertise of the presenter and the facts at hand. The organization has a culture that radiates high-tech expertise in R&D methodologies. New employees to the organization quickly discover that the road to advancement is through hard work, careful and logical thinking, and dispassionate presentation of their opinions.

## ***Philosophy***

Philosophy grows out of the genetic core. It is the basis for the organization's value system and beliefs that guide employee (e.g., researcher) decision making, behavior, and expectations. The current trend is to make the philosophy real through vision statements and reward systems, but it is more than this. Philosophy provides a framework for making ethical and moral decisions, for determining the culturally sanctioned rights and wrongs. It creates a "should-do" set, that is, a list of what managers and employees should do, how they should behave, and what they should believe.

To be operational, philosophy must be lived. Employees wait to see if leaders are serious enough about the changes that they are introducing to act the way they say that others should act. After decades of corporate programs-of-the-month, slogans on the walls, and motivational gimmicks of the moment, employees are wary of words. In considering whether they should buy into the change, they wait to see if the leaders are

willing to change their behavior, to enact the philosophy in the executive suite as well as throughout the working environment.

## **Behaviors**

The inherent philosophy creates a set of normative behaviors. What can be done? Why are certain decisions made? How are interactions with those above or below in the hierarchy handled? How are personal crises that affect professional lives handled? How is cross-functional work performed? What methods are used for problem solving and trouble shooting? What training approaches are relied upon? All these questions are answered indirectly by normative behaviors.

*Normative behaviors are the most resistant to change.* They are an invisible web that ensnares everyone in an organization (i.e., hangs everyone up in the small things that are done on a day-to-day basis). Acting in a manner outside the set of normative behaviors is usually taboo; even in the high-tech R&D environment, there are norms to be followed.

Leaders often find that asking employees to break normative behavior standards creates incredulous responses. Employees simply believe that leaders do not mean what they are saying. Frequently, executives who ask staff to share their honest reactions to an issue receive no answers, then are given feedback that no one really believes that executives mean what they say.

When a new executive asked for feedback and criticism on the recently developed philosophy statement, no formal response was received. When the employees were asked why by a consultant, they responded that they knew the executives did not really want their feedback. They were well aware that the normative behavior in the organization was to pretend to be interested in feedback, and they had no intention of breaking the norm. I have noted that *this behavior is radically changing both in government organizations and in outside industry as well.* But we have a long way to go. Change will not happen overnight.

Normative behavior is easier to see and untangle by a relatively objective outsider. New employees watch how their peers act to determine what the unspoken rules are, to learn to behave within the organization. They learn by deducting the real philosophy, embedded in the behavior component, by observing and mimicking the interactions around them.

## **Formal Organizations**

The organizational structure demonstrates to everyone what jobs, reporting relationships, and career paths have more value to the organization. In theory, the formal organization manifests the philosophy that prescribes both acceptable and unacceptable behaviors for employees. In reality, most formal organizational structures demonstrate and reflect the inconsistency of life in general. Generations of management have tinkered with the formal structure, have changed a reporting structure here, reorganized there, and created a structure that sends conflicting messages about what the philosophy really states.

For example, organizations that empower employees frequently still retain five or more layers of management. Although management may really mean to delegate responsibility and authority, the organization's structure is still sending a different message.

The formal organization is the easiest to change and is consequently often the target of change processes, even when it is not the segment that can contribute most meaningfully to a constructive, profitable change process. The question is: "Why?"

It is the segment that leaders are trained and educated to manage. It is the segment that everyone understands and feels comfortable with. It is the segment that is the most tangible, traditional, and malleable. It can easily be converted into boxes and reporting relationships, dollars and cents, flow of goods or services through the organization, or inventory at hand.

It is known and understood; in times of change, when everything else seems to be changing, it is returned to for comfort and security. Unfortunately, in today's world of rapid change and globalization, where a high degree of teamwork and communication is needed, it must be congruently aligned, periodically adjusted, and de-emphasized.

No matter how much a leader emphasizes change, until the formal organization is congruent with the philosophy, change will be slow at best. A simpler structure is usually the best strategy. Employees are steeped in the inconsistencies and contradictions of organizations. Many are experts at discovering loopholes in organizational policy and procedures, using the loopholes to their own advantage, and causing management to create more policy and procedures to close the loopholes. This circular behavior of action and reaction causes redundancy and creates bureaucracy. Rather than try to address the problem within the formal organization, leaders need to develop a strategy to counter the problem through another component.

### ***Information and Engineering Systems Technology***

IS/EI technology systems are the structures, constraints, and demands of the communication within an organization. Every IS/EI system creates in people a set of beliefs, values, and attitudes. On-line, real-time IS/EI systems demand precision and accuracy to function effectively. Employees quickly adopt beliefs that mirror the demands of the IS and EI systems.

An organization's technology systems set the rhythm and tone for everyone. Service organizations move to a faster beat when working in a high-tech R&D environment. Organizations that measure output on a daily basis have a much different rhythm to their workday than those that measure their output on a quarterly basis. The different rhythms, tones, and beats of organizations create different styles appealing to different types of people, need different structures and rewards, and generate unique sets of behaviors. This is especially true in high-tech R&D environments such as the DOE National Laboratories.

Another high-tech R&D environment is the software industry. For example, Microsoft Corporation's culture believes in using the computer as a major vehicle for communication, frowns on the use of paper to communicate, values communicating by computers as a way to minimize the use of natural resources, and thus creates an attitude of new-wave superiority with its employees. Microsoft rewards its people differently than most organizations, and demands more productivity. The rhythm and tone of Microsoft is centered around its IS/EI systems.

### ***Informal Organization***

In formal organizations, structure evolves and is often considered unmanageable. Informally, employees know who the real leaders are, who has the necessary information, and who can get things done. They work around the barriers of the formal

organization to obtain what they need, to get done what they must. In organizations where the formal and informal organization are incongruent, the formal organization's strategy is survival, making the organization work despite itself. In organizations that have the formal and informal in balance, however, the informal organizational strategy is to enhance an organization, frequently creating an innovative environment.

Employees are masterful at working around the barriers, at accepting the barriers as institutional sacred cows, and at carefully avoiding disturbing the creators or protectors of the barriers. They understand the natural human desire to have sacred cows, create rationales and explanations for the existence of the sacred cows, and carefully pass on this information to succeeding generations. The grapevine is the predominant communication tool of the informal organization and is used to carry the information necessary for survival. Frequently, new employees are taken aside by an organization's veteran who explains how things "really work."

The informal organization has its own set of leaders, its own structure and reward systems, and, frequently, its own subculture. The leaders are people who are not in formal leadership positions; they lead by virtue of their ability to personally influence their peers, command respect by their ability to speak well, have access to information, or predict organizational behavior.

The informal structures are based on personal friendships, collegial acquaintanceships, or other informal relationships. The informal structures rewards through classic peer-group mechanisms, valuing loyalty to the group, conformity to peer expectations, and contribution to the IS/EI group(s) effort.

Employees are rewarded within the informal culture by support from their peers, assistance with difficult projects, sharing of interesting or helpful information, and acceptance in a network. The informal organization develops its own values, beliefs, and attitudes through the sharing inherent in the network.

## ***Culture***

Culture is difficult to identify and harder to change, although cultures can be changed. They certainly change as the organization changes, whether the change is desirable or not. The organization's culture evolves slowly and becomes evident in many small ways. It can be seen indirectly on the walls of corporate headquarters, throughout various office facilities, and in the restrooms. The cleanliness of hallways sends a message about the culture; the comfort of the chairs in a meeting room indicates a message about the importance of people; and the layout of the offices sends another message altogether. Symbols, myths, legacies, and stories abound in the organizational culture. Each fragment reflects what the organization has been, what it is, and what its people collectively believe. Culture is like a Jungian collective unconsciousness of the organization.

Leaders can view cultures as dependent or independent variable, as a segment that acts as a barometer of change in the other segments, or as the segment to change directly, as a driver of change throughout the other segments of the IS/EI organization. If leaders use the culture mainly as a barometer, they can quickly and easily assess the degree of change by asking a few strategic questions. Leaders can ask, directly or indirectly: "What does everyone know here but never say?" Or, they might request an answer to "The one thing that I would change here, but that management never will change is . . .?" The answers indicate the degree to which issues are hidden beneath the formal organizational surface and remain unaddressed. The answers also indicate what issues must be addressed for the change to be successful.

If leaders use the culture component as a driver for change, they must directly address the organization's values, myths, and beliefs. Although initially difficult for many executives, employees find this approach very freeing.

Discussions about the organization's values allow employees to discuss the organization without talking about individuals and distancing the topic personally. Everyone can openly discuss how an organization says it is customer-oriented, but in reality employees choose to please their bosses before pleasing the customers. Discussing values allows everyone to share the blame and also encourages everyone to take responsibility for change.

## **Understanding the Complexities of Change**

Guiding the process requires recognizing which aspect of an organization's IS/EI system can be most easily changed. Most managers are already well aware that changing one segment of an IS/EI system automatically changes aspects of that system, and it can be assumed that management's choices will significantly affect the IS/EI system no matter which segment they go after. Because the effect can be positive or negative, leaders must choose wisely, based on the status of the organization's IS/EI systems technology.

The preferred means is to change the genetic core by bringing in new senior management. But the change often fails because no one leads the changes in the other segments, and the genetic core provided by the new senior management IS/EI team cannot take root. Eventually, the new IS/EI team leaves. This can be evidenced by listing all the organizations that have appointed new IS/EI teams within the last two years and then dismissed them (or they found new jobs and left the organization). Presumably, not all the IS/EI teams were incompetent when hired or brought into the organization within the corporation itself. So some other factor must be at work causing their failure.

An equally favorite strategy is to change the formal IS/EI organization. They redesign the organizational chart, centralize, decentralize, outsource, and rightsize. But often these changes are only superficial. The culture and informal organization do not change; they often go underground, waiting for the formal shifts to die off so that everything can return to the way it has always been.

More recently, IS/EI organizations try to change the culture. They create new cultural artifacts, new rituals, new buzzwords. And sometimes, when the organization has committed the necessary years, budgets, and energy, the change works. More often, management becomes pressured to achieve immediate results, become worried by the ongoing and intermittent forms of chaos, and they change direction. The culture and informal IS/EI organization learns new ways to block change, and future changes are stalled at the start.

Increasingly, organizations are focusing on IS/EI systems technology to create change throughout the entire organization. Managers who have been stymied trying to change the organizational culture, or had hoped for major productivity gains after significant reorganizations, are finding the power of using the IS/EI systems technologies to spearhead the change throughout the organization.

When these change strategies fail it is because they do not address the complexity of the interlocking organization. Managers need to develop strategies that capitalize on the jigsaw puzzle effect and leverage change in one component by changing others. Like the work rules example mentioned earlier, changes in the formal organization require change in the culture and behavior components.

Any change made in the communication processes within the formal organization component will drive a corresponding and equal amount of change in the informal organization's grapevine. This will in turn affect employee behavior as they receive normal organizational communication in a different format, different quantities, or quality. They will interpret the format by giving it organizational meaning and adjust their behavior accordingly. Within the high-tech R&D environment, this philosophy and behavior is changing the IS/EI systems technology at a very rapid pace.

For example, let's look at what rumors can do to an organization. We have all faced this situation in one form or another. An organization's management decided that it needed to address the erroneous information on the grapevine. The incorrect information circulated by the grapevine was causing a great deal of confusion, and many staff members were making decisions based on this misinformation. The management team for the IS/EI system decided to correct the problem by increasing the frequency and the amount of formal information. The strategy was to increase the formal flow of information so that the staffs' need to get information through the grapevine would decrease. This, in turn, would then allow the staff to make better informed decisions.

Immediately after the annual planning meeting, the management team took two steps. The department executive wrote a memo detailing all the issues discussed at the meeting and outlined the plan. Second, members of the IS/EI systems team met with staff in question-and-answer meetings to discuss any topic related to the annual planning meeting. These two steps met the IS/EI systems technology needs of the staff and virtually eliminated the usual rumors that circulated on the grapevine. The real benefit came from the increased buy-in by the staff to meet the goals of the plan. Now that they understood it unclouded by rumors and had a chance to discuss it, they accepted and supported the plan.

Taking this approach has improved communication within the Lawrence Livermore National Laboratory (LLNL), the Department of Energy (DOE), Department of Defense (DOD) and many other internal and external organizations many times over.

Understanding the complexities of organizational interrelationships is the key to developing these types of strategies. Once managers think through the relationships, following the interconnected trails and using them to leverage change, they are ready to develop a plan for change.

## **Processes of Change**

Traditional implementation plans partially understand and capitalize on the interlocking nature of organizational components. Leaders guide the change through the veil of the new philosophy, changing aspects of the organization's formal organizational systems to be consistent with the new philosophy. In the high-tech R&D environment, this new philosophy functions very well. As the formal organization systems change, employees begin to shift their beliefs, then their behavior to be consistent with the tenets of the new philosophy. Employees implement the changes in the IS/EI systems by meeting in small groups and deciding to make specific changes. The assumption is that those employees closest to the details will make the best choices.

This assumption is seductive and only partially valid. Those closer to the details do understand the details better and are more likely to understand the real barriers to improving processes. However, they can change only the processes directly tied to their personnel perceptions of the vision and the philosophy. Their viewpoints are necessarily narrowly focused.

The assumption also includes another seductive trap: people will change once a rational, valid argument is presented to them. If this were true, there would be no need for innovative medical and marketing devices to help people stop smoking cigarettes. Unquestionably, employees must be involved in driving the details of change, but their contributions require guidance from managers who have a far broader perspective of the change process and its direction.

The traditional approach fails to manage the jigsaw puzzle effect. *Changing the philosophy and the formal structure is frequently not enough.* The invisible web of normative behaviors, of historically rooted myths and beliefs, as well as lack of support from key informal leaders prevents the changes from taking root within the fabric of the organization. *Managers must weave change through all the organizational components to ensure success.*

### ***Additional Steps***

Managers must take three steps in addition to those in the traditional approach:

- First, they must make a careful, thorough, sensitive diagnosis of where the organization needs to be in the future versus where it is now. Using the seven organizational components as a model, they must develop a profile of each component as it will be in the future and as it is now. Comparing the future state versus the present state quickly reveals the macro-changes that need to be made. In addition, managers can intuitively see how a change in one component connects to the others and can sequence the changes in one component to support the others.
- Second, management must identify which segment or segments of the organizational IS/EI system can optimally lead the change. Often this will be obvious in the profiling process. Many organizations need to start in nontraditional components (e.g., behavior or the informal organization). Other managers have found that they must initiate change in several organizations and/or groups at one time, blending the traditional approach of changing the philosophy with changes in the culture and behavior.
- Third, managers must realize that, although any organizational change begins with them, rests on their initiatives and attitudes, the change belongs to the employees. Managers need to visualize the need for change, and the opportunities available if change occurs. But the employees own the change. Most likely, they will be with the organization long after the current executives has left, and they will either continue the change, discontinue the change, or change the change. Managers must design change processes that enable the employees to buy into the change, make it the change that best fits them and the new direction of the organization, and then allow the employees to own the change. *Successful change is the top-down and bottom-up philosophy.*

Leaders must develop a change process that is multifaceted, that links formal and informal leaders together, that seizes opportunities for change in each segment of the organization. Equally important, managers must ensure consistency of vision and allow functions and organization to develop a vision for their own areas. *Everyone needs a clear understanding of the boundaries of their personal role, group role, and division and/or departmental role.*

For example, the LLNL Plant Engineering organization must develop and understand the complexities of its own CQI (continuous quality improvement) model within the confines of the broader LLNL model. The employees of each division and/or

department must translate the vision and philosophy into a detailed workable model that is applicable to the inner workings of their area and possible within their division and/or departments. The employees must be allowed to dream their functional vision, to reach out for the ideal division and/or department that they believe in. Then they can change the other six organizational segments with the departments.

Once employees lead the change, managers have answered the questions of how to guide the organization through change while minimizing pain for the people and the organization. The process will not be painless, but it will be as minimally painful as possible. When employees are leading the change, managers know they also have the right people for tomorrow. Some of the employees that are not right for the future will leave, and possibly move to another position within the organization. The percentage of future-oriented employees that stay will increase by using this process as compared to a top-down, right-sizing process.

Finally, by empowering the employees to lead the change process, managers have taught the organization to self-manage ongoing change. Once employees understand and internalize the need to lead ongoing change, once they have practiced it for several years and management has allowed them to guide the change in their own functions, then they have learned how to manage continuous change. Suddenly, managing change has become a sacred cow, a legacy passed on and cherished throughout the years.



## ***Hypothetical Case***

Here is an hypothetical case of a small, high-tech manufacturing company whose executives determined that unless the company shifted from a production orientation to a market and customer orientation, it would never grow fast enough to survive in its market places. The company had a long history of brilliant technical innovations that were never leveraged for growth. The company was more interested in creating an innovative technical solution for a customer and then moving on to the next problem, rather than converting the innovation to a standard product. Consequently, the company was stuck in a nongrowth cycle of investing in a new product development without long-term profits. The strategic solution was to refocus the company on its markets and customers, moving away from solely focusing on engineering and technical brilliance.

The executive team was also faced with another historical problem. The company had been bought and sold eight times in 12 years, with each new owner determined to shift the focus of the company to markets and customers. Every corporate owner had grown weary of trying to manage the shift and decided that selling the company was easier than managing change. The company's managers and employees had become experts in resisting change, in waiting to be sold, and in continuing to operate the company in the way that they preferred, with the focus on technical brilliance. For the executive team to be successful in implementing the change, it had to move beyond the traditional change-management approach.

Executives and managers profiled the company's components and could clearly see that the informal organizational network completely supported the status quo and resisted any change. Over the years, the informal organizational component had become the strongest and most cohesive aspect of the company. Its strength compensated for the weaknesses in the rest of the organizational components, which managers and employees viewed as controlled by the corporate owners. Like orphans, the managers and employees developed a survival strategy of avoiding fights with the more powerful owners in areas that had no hope of winning.

Consequently, no matter how the company was structured, no matter how much planning was done, the managers and employees supported each other in doing what they always had done—innovative brilliance. Everyone knew they would be sold shortly and that all the promised monetary rewards, all the glowing visions of growth and expansion, would ultimately disappear. The only lasting satisfaction came from developing technical innovations.

The question now was: "How to rectify this situation and still have a company left that would not fail?"

The executives and management team developed a two-pronged strategy for change. Together, they would develop a philosophy and mission that included the historic values while incorporating the new values of market and customer orientation. They agreed the company could be both rather than just one or the other. Second, they would *begin the change in the informal culture* and its associated components, identifying those actions and beliefs that had to change. They decided that they needed to change the grapevine that supported the status quo and carried false and vicious rumors about any new managers and employees. They chose to end the dinner parties that predictably fostered discussion and support for past technical triumphs, and to deliberately include new executives, managers, and employees in the social gatherings.

They supported this strategy with complementary changes in the formal organization and behavior components. Formal communication was greatly increased

to counter the information flow through the grapevine. Minutes were taken in all meetings and distributed to everyone interested. Meeting behavior was changed by encouraging participants to disagree in public and to refuse to discuss issues without including the key parties. Anyone hearing a rumor was encouraged to research the facts and openly reveal the real story, and to put the information into the formal organizational component rather than the grapevine.

Finally, the executives and managers understood that this change belonged to the employees. If it was to be successful, each person would have to understand the desired change and interpret it to fit their particular situation within the company. Therefore, everyone would have to be involved in a process similar to that of management. They would need to discuss how the company philosophy affected their department, how it would change daily work routines, and how they would implement this in their own areas. Once they began to lead the changes in their areas, the shift from technical brilliance to overall brilliance was ensured. The employees now owned the change and were able to modify it to fit the needs of daily work as well as the strategic need of the company.

## **Closing Comments**

The key to a successful change process is to understand the complexity of organizations, diagnose which organizational component gives optimal access to changing, harness all the segments using appropriate processes, and let the chaos work itself out so that eventually, with management, the chaos can be guided towards a fruitful conclusion. *No change process will be successful unless the employees own the change and adapt to meet their unique needs.*

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## Appendix A. Summary Comparison of QIP, BPR, and Downsizing

<b>Quality Improvement Program (QIP)</b>	<b>Business Process Reengineering (BPR)</b>	<b>Downsizing</b>
<b>Primary Purpose</b>	<b>Primary Purpose</b>	<b>Primary Purpose</b>
Product/service quality improvement to increase customer satisfaction	Process redesign for improved organization effectiveness	Cost reduction & financial performance via personnel/layoffs
<b>Types of Companies</b>	<b>Types of Companies</b>	<b>Types of Companies</b>
QIP began with manufacturing companies, but has spread	All. Frequently used in service & financial parts of companies	All
<b>Reasons for initiation</b>	<b>Reasons for initiation</b>	<b>Reasons for initiation</b>
To improve long-term market position	Often to take advantage of information technologies	In response to a financial performance crisis
<b>Time Horizon</b>	<b>Time Horizon</b>	<b>Time Horizon</b>
Long-term	Medium-term	Immediate
<b>Success Rate</b>	<b>Success Rate</b>	<b>Success Rate</b>
Mixed, a few full & many partial successes	Most projects are successful	Immediate savings often are less than expected; may jeopardize future operations
<b>Impact on Organization Culture &amp; Values</b>	<b>Impact on Organization Culture &amp; Values</b>	<b>Impact on Organization Culture &amp; Values</b>
Good to excellent; QIP is a philosophy of values	Neutral to good; can enhance morale	Destroys values, such as loyalty and morale
<b>Cost to Implement</b>	<b>Cost to Implement</b>	<b>Cost to Implement</b>
High, often gradually offset by decreasing costs of operations & greater profitability	Medium, quickly offset by combined greater effectiveness & cost savings	Modest but significant; includes costs of early retirements

<b>Quality Improvement Program (QIP)</b>	<b>Business Process Reengineering (BPR)</b>	<b>Downsizing</b>
<b>Nature of Activity</b>	<b>Nature of Activity</b>	<b>Nature of Activity</b>
An integrated, multifaceted program	A series of projects that can sum to a loose-knit program	A one-shot activity, sometimes repeated
<b>Scope</b>	<b>Scope</b>	<b>Scope</b>
Primarily in manufacturing & direct customer services, can spread	In operations, administrative & management processes on a project-by-project basis	Can be by department, by division, or company wide
<b>Strongest Secondary Effects</b>	<b>Strongest Secondary Effects</b>	<b>Strongest Secondary Effects</b>
(a) Increases competitiveness by increasing quality; (b) gives organization an esprit	(a) Reduces costs; (b) increases competitiveness	Reduces morale, reduces organizational effectiveness
<b>Role of Information Technology</b>	<b>Role of Information Technology</b>	<b>Role of Information Technology</b>
Incidental & routine use of it	IT is critical as BPR enabler	IT is tangential consideration or irrelevant
<b>Most Critical Success Factors</b>	<b>Most Critical Success Factors</b>	<b>Most Critical Success Factors</b>
(a) Senior management's deep involvement & direct participation; (b) steadfastness of purpose; (c) long-term commitment	Full understanding by process personnel of the need for BPR; development of good supporting information and engineering systems technology	Ability to impose the will of top management down through the hierarchy
<b>Who Conducts the Activity</b>	<b>Who Conducts the Activity</b>	<b>Who Conducts the Activity</b>
Senior management, along with everyone involved	Senior management sponsorship, BPR analysts, and employees involved in the process tasks	Senior management determines the program, other managers carry it out
<b>Skill-Building Attributes</b>	<b>Skill-Building Attributes</b>	<b>Skill-Building Attributes</b>
Builds valuable skills	Alters skill requirements of a process task set	Tends to de-skill the company

**Quality Improvement Program  
(QIP)**

**Responsiveness to  
Customer Needs**

Yes, focus is on customer satisfaction

**Business Process Reengineering  
(BPR)**

**Responsiveness to  
Customer Needs**

Directly for customer interaction processes; indirectly if at all for other processes

**Downsizing**

**Responsiveness to  
Customer Needs**

No, unless it causes lower prices; may negatively impact customer service and product quality

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## **Appendix C. Glossary**

IS	information systems
EI	engineering information
DOE	Department of Energy
R&D	research and development
TQM	total quality management
IT	information technology
FMS	flexible manufacturing systems
BPR	business process reengineering
QIP	quality improvement programs
JIT	just-in-time
EDI	electronic data interchange
CFS	critical success factors
CAM	computer-aided manufacturing
AI	artificial intelligence
ROI	return-on- investment
BPR	business process reengineering
STS	Socio-technical systems
CQI	continuous quality improvement